

# Wind and Water Sediment Transport Under Climate Extremes and Land Management Practices

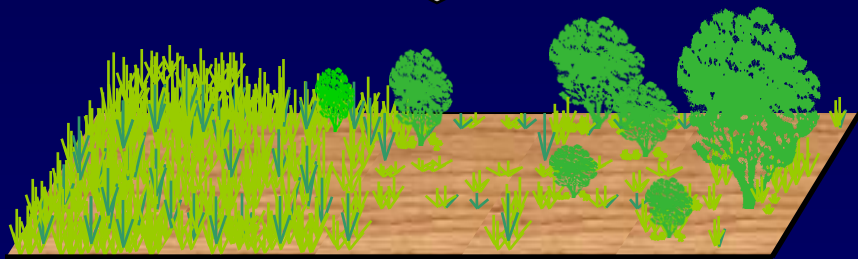
**Jason Field**

School of Natural Resources and the Environment  
University of Arizona



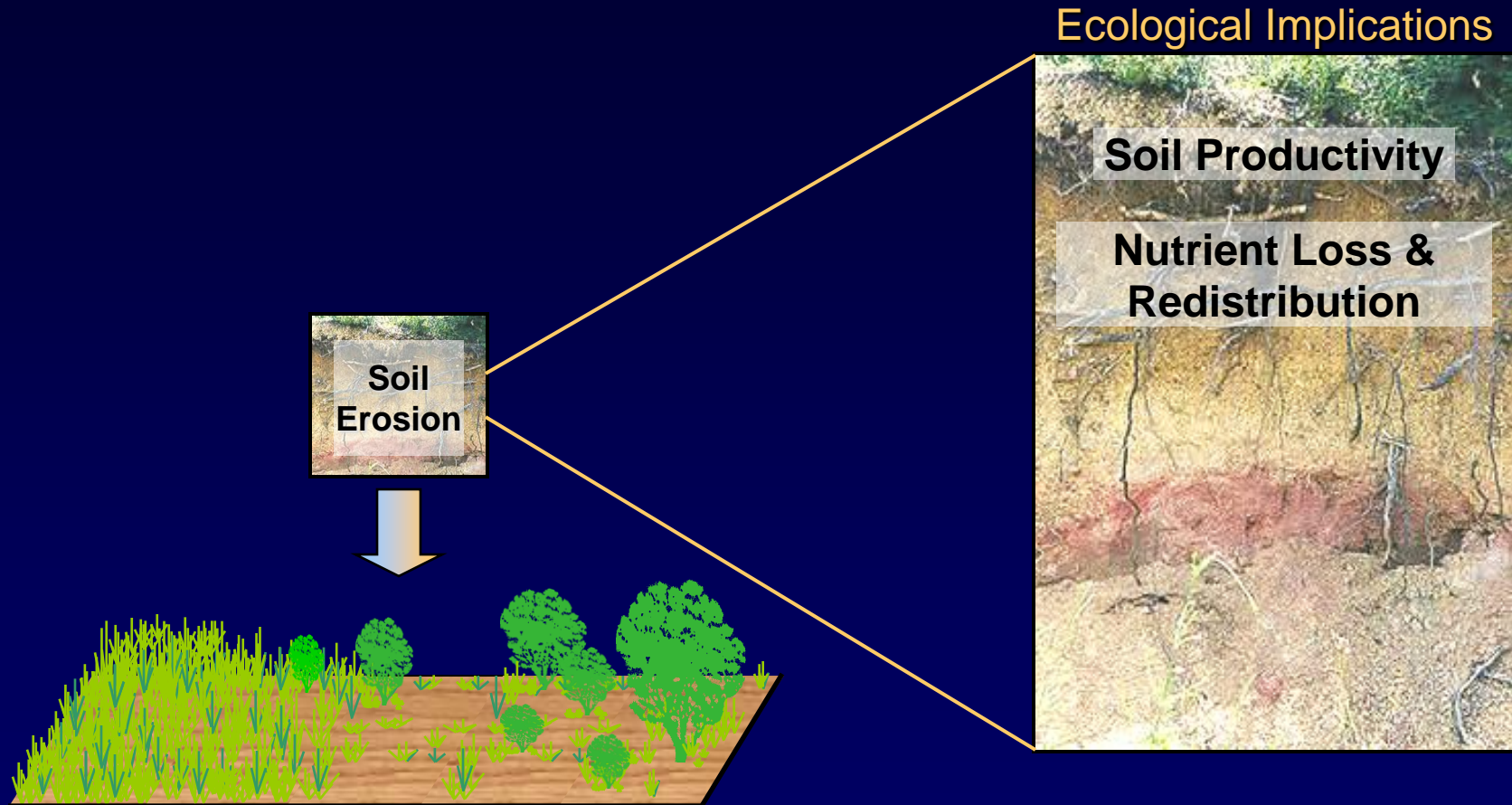
# Soil Erosion: Ecological Implications

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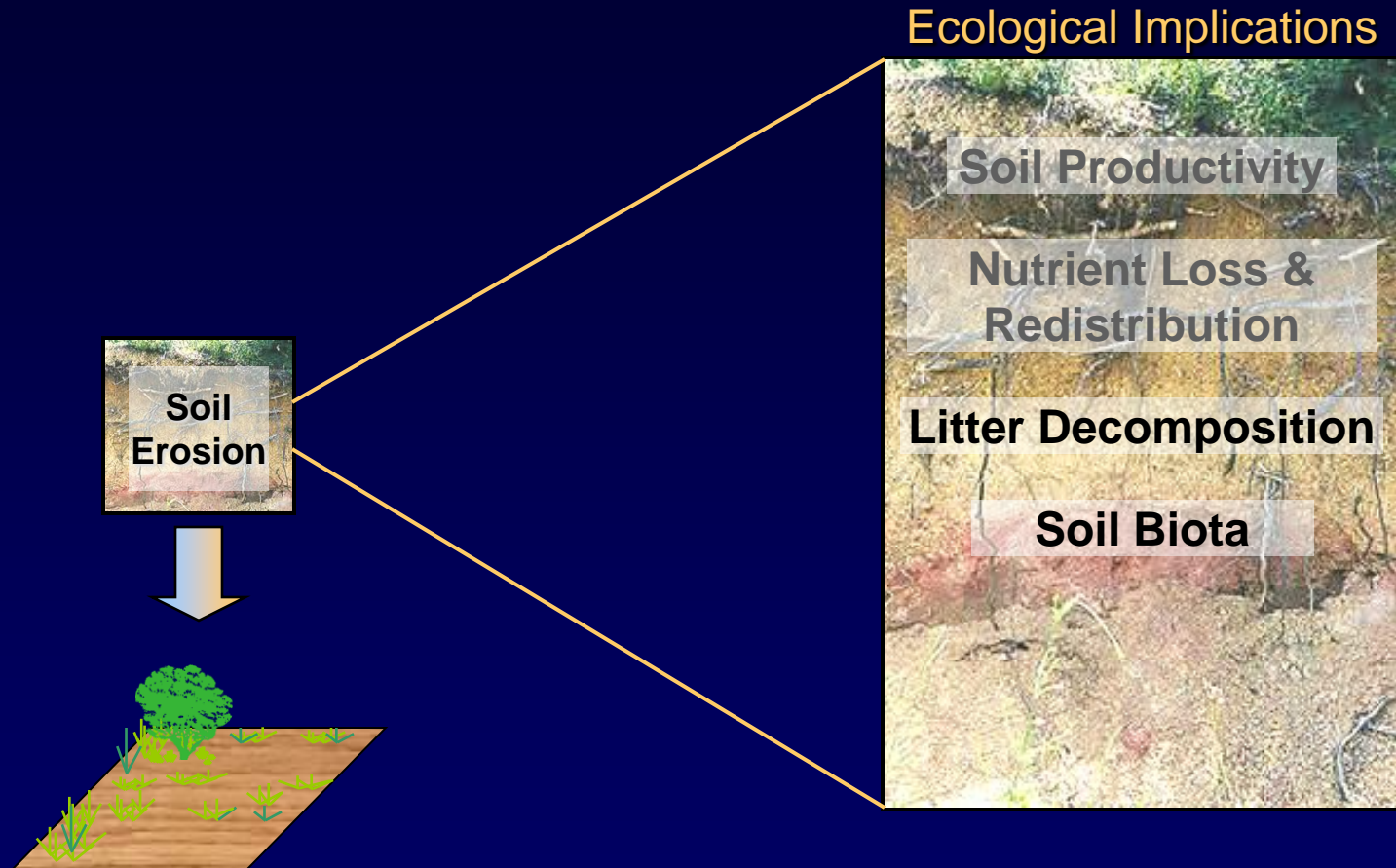




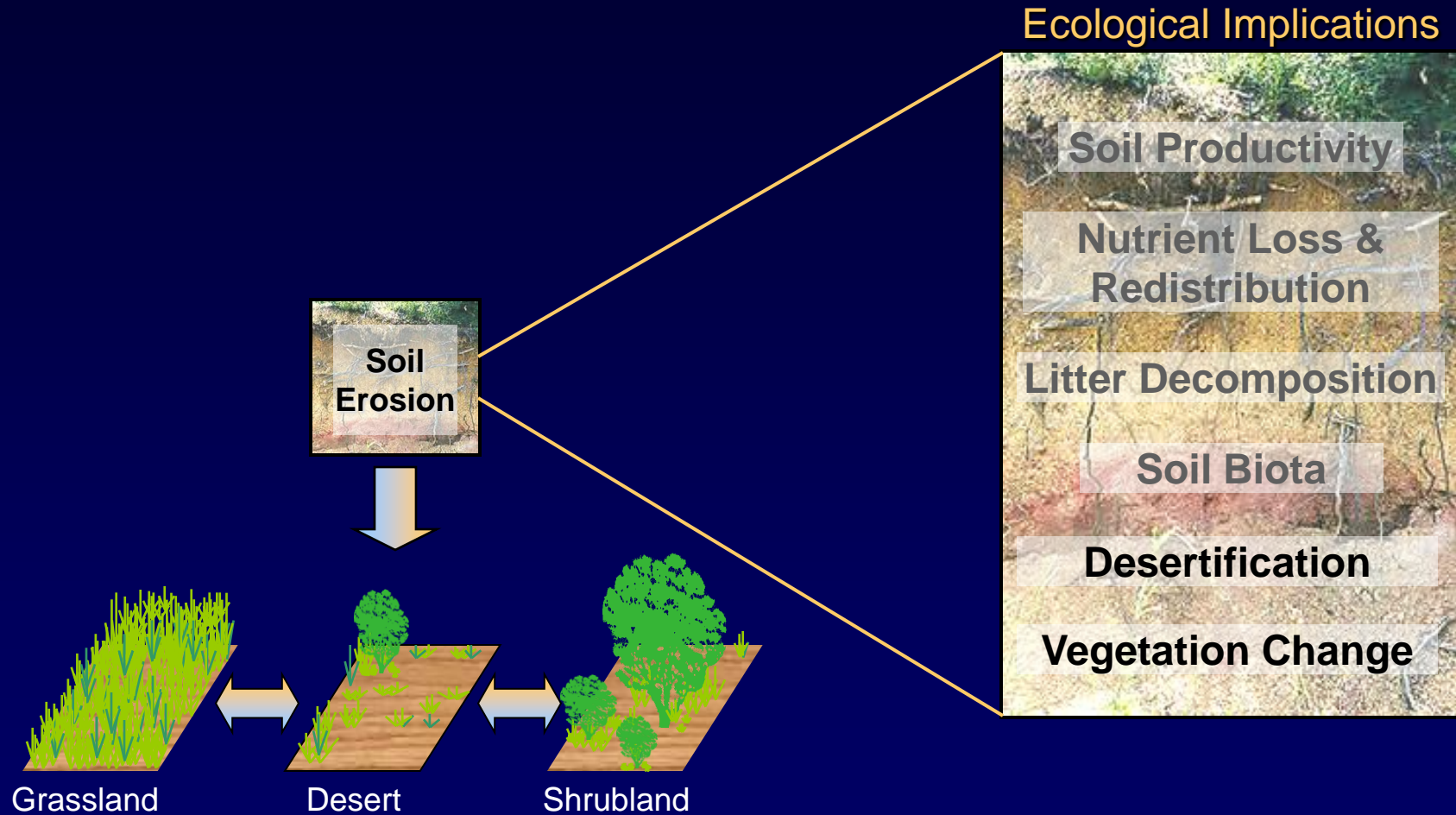
# Soil Erosion: Ecological Implications



# Soil Erosion: Ecological Implications

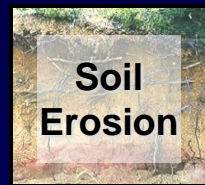


# Soil Erosion: Ecological Implications

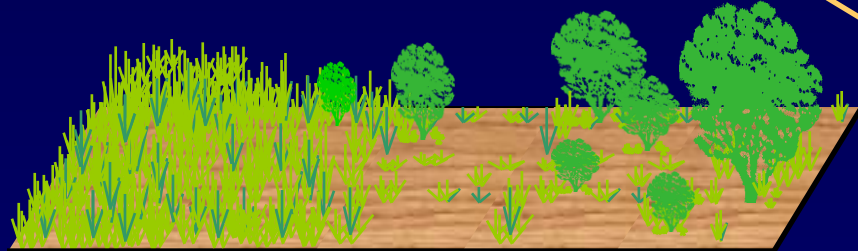




# Soil Erosion: Wind & Water Components

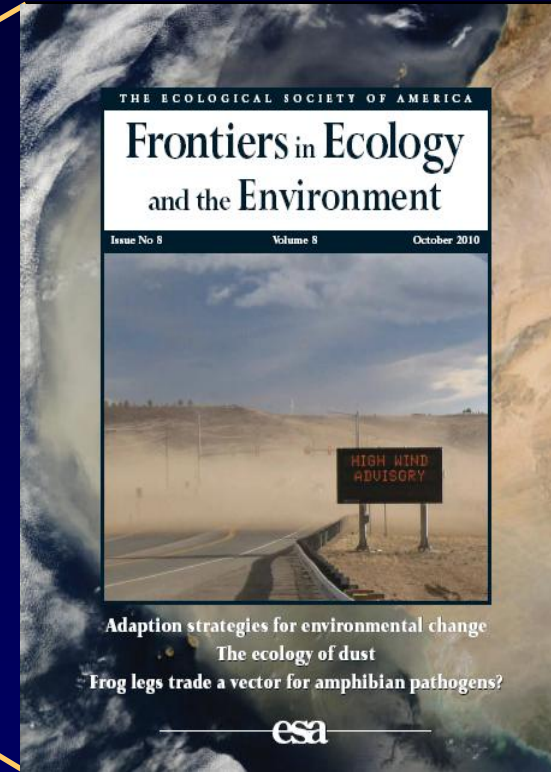


Soil  
Erosion



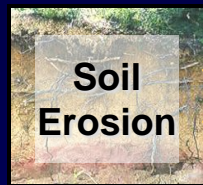
Vegetation Dynamics

## The Ecology of Dust

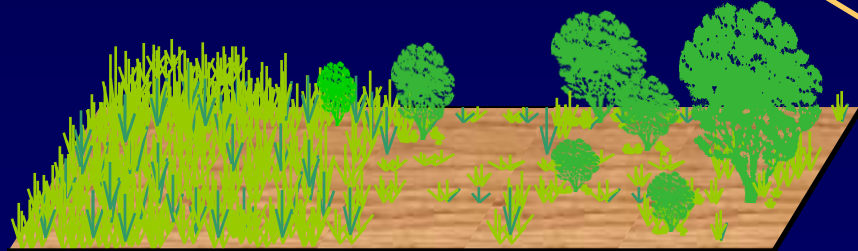


Field et al. (2010) Frontiers Eco & Environ

# Soil Erosion: Wind & Water Components

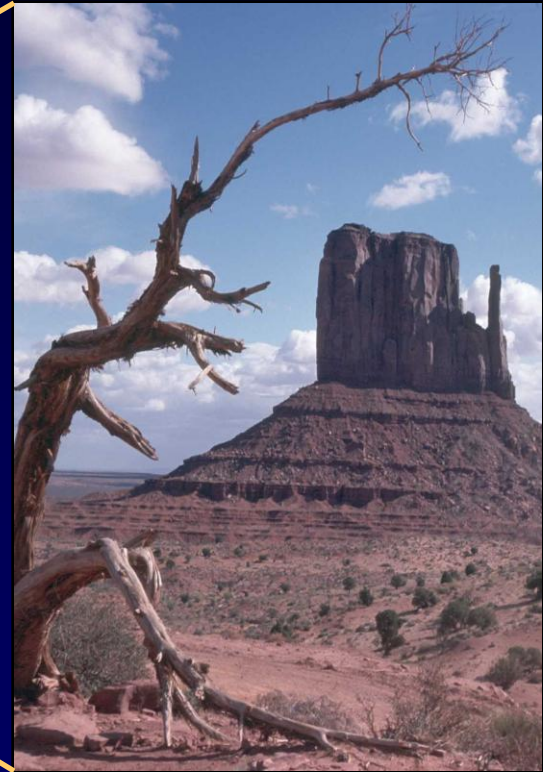


Soil  
Erosion



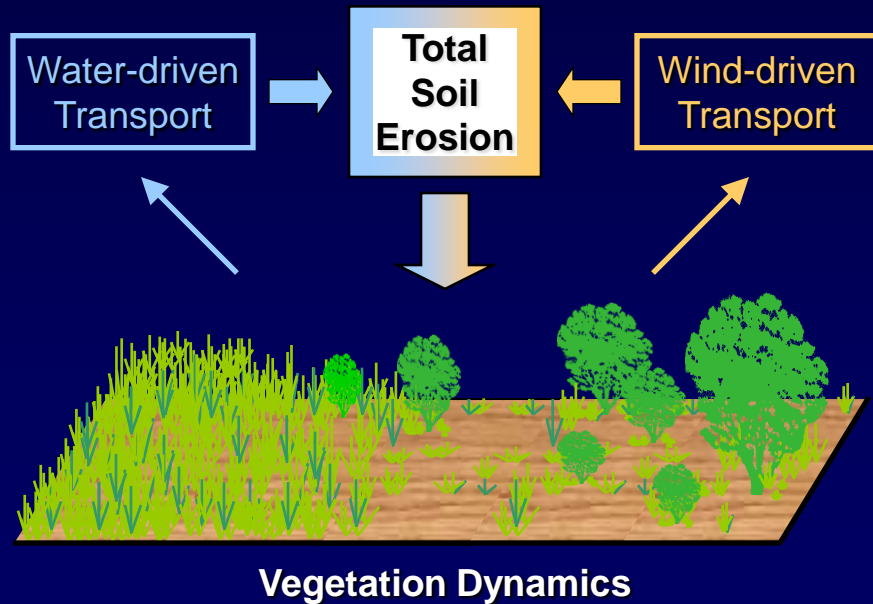
**Vegetation Dynamics**

Monument Valley, AZ

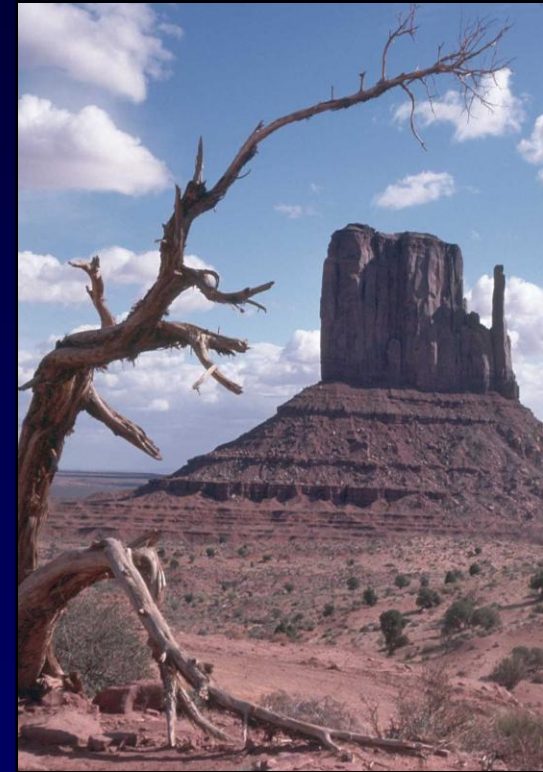


Towering mesas of sandstone  
formed by wind and water erosion.  
NRCS Photo NRCSAZ86001

# Soil Erosion: Wind & Water Components



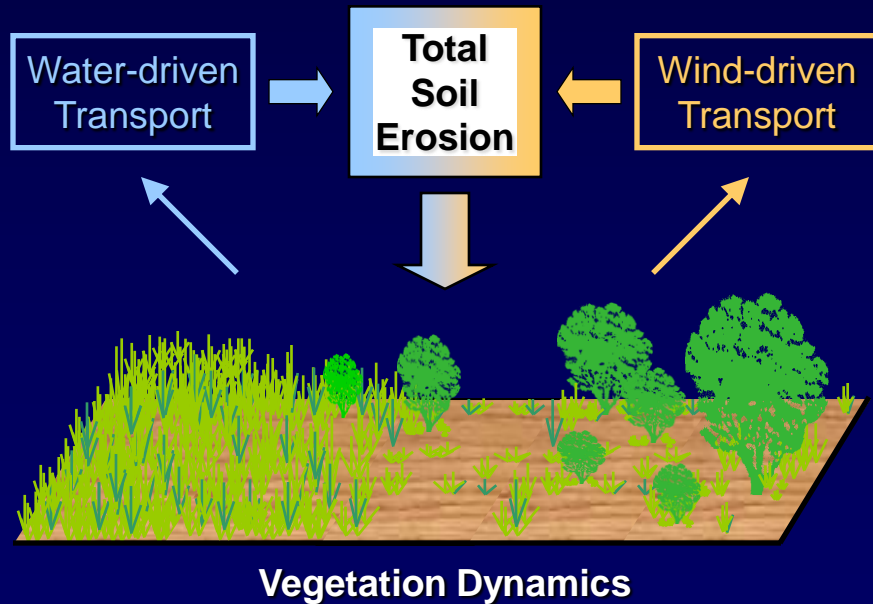
Monument Valley, AZ



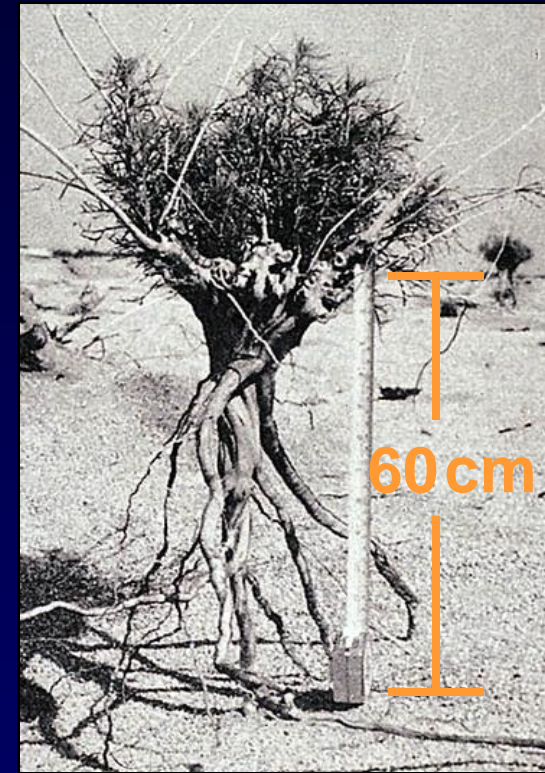
Towering mesas of sandstone  
formed by wind and water erosion.  
NRCS Photo NRCSAZ86001



# Soil Erosion: Wind & Water Components



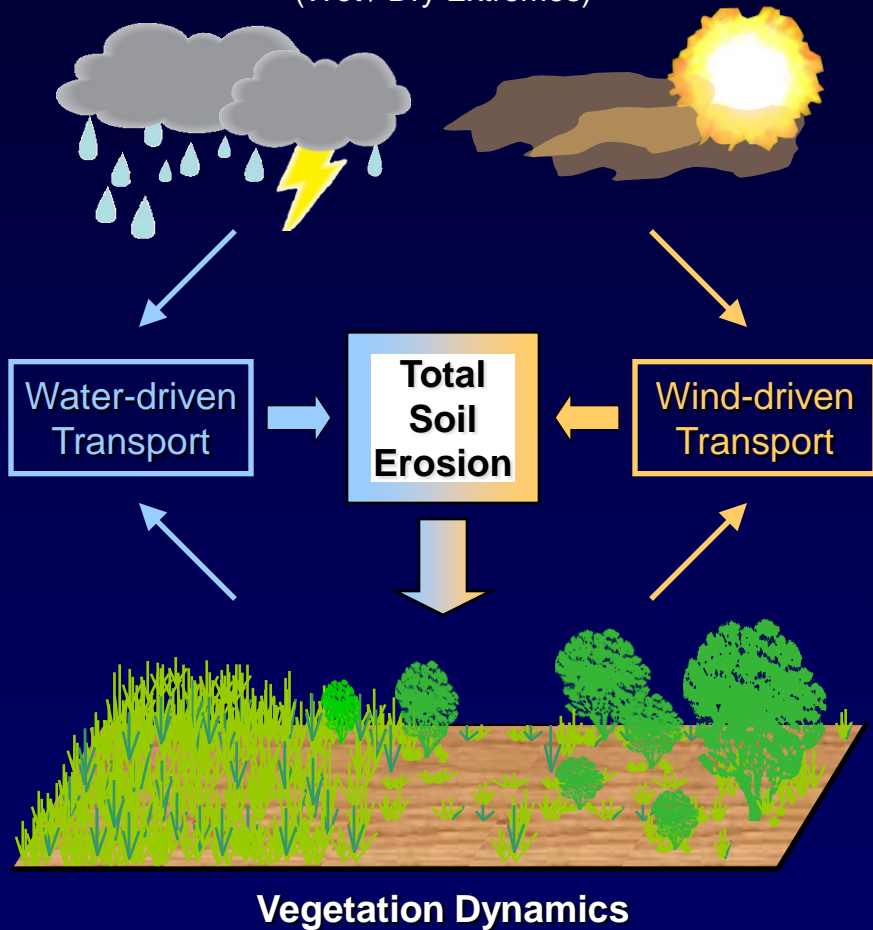
San Joaquin Valley, CA



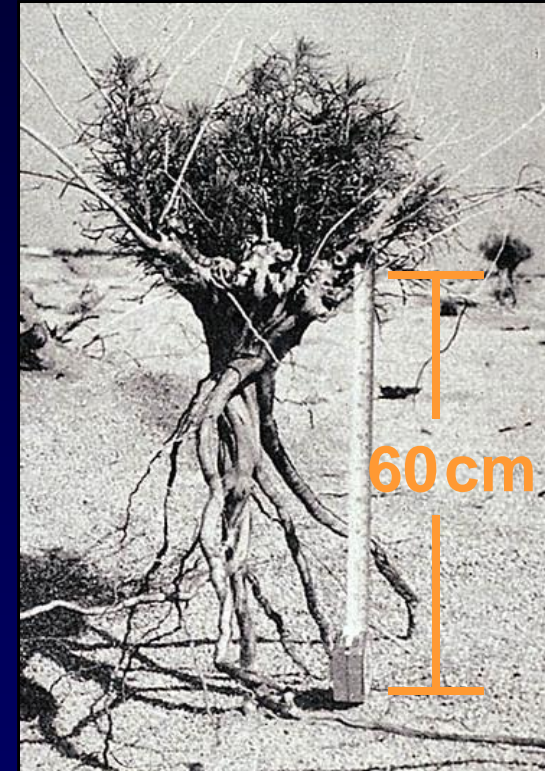
60 cm of soil loss in a single wind event in San Joaquin Valley (Wilshire et al. 1981)

# Soil Erosion: Climate Extremes

**Climatic Conditions**  
(Wet / Dry Extremes)



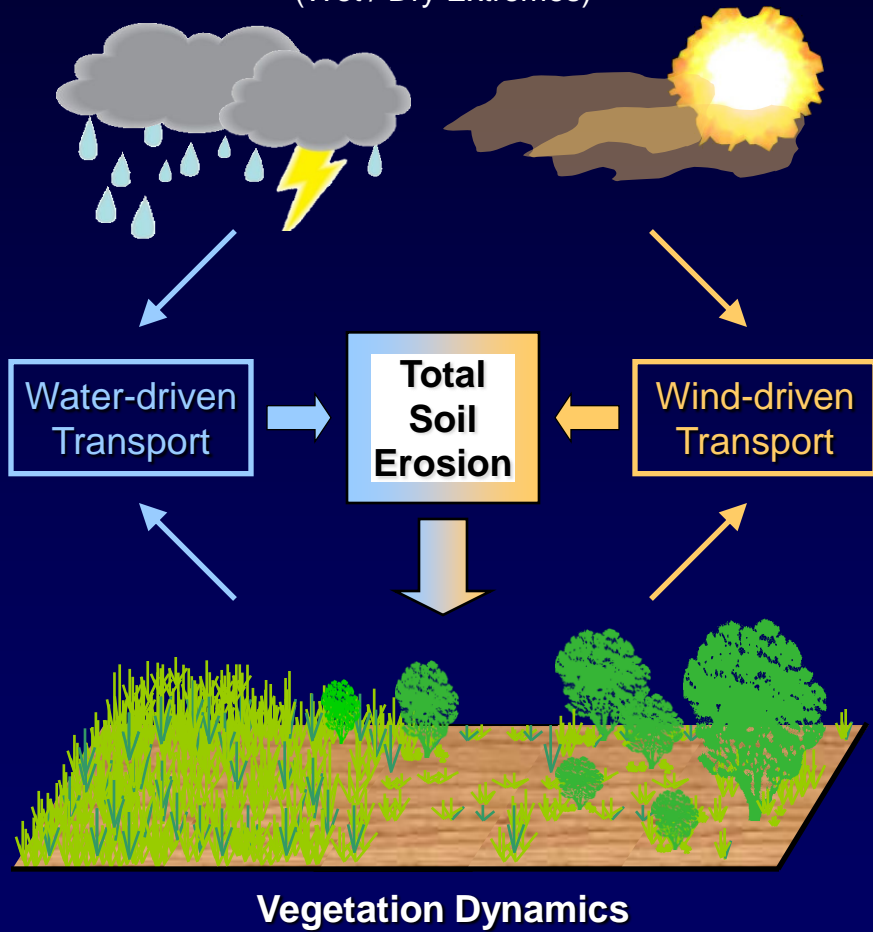
**San Joaquin Valley, CA**



**60 cm** of soil loss in a single wind event in San Joaquin Valley  
(Wilshire et al. 1981)

# Soil Erosion: Climate Extremes

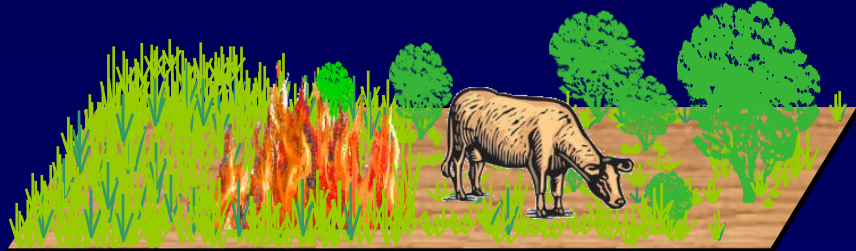
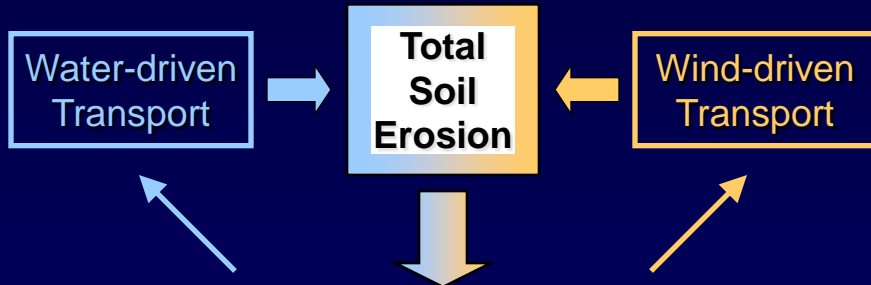
**Climatic Conditions**  
(Wet / Dry Extremes)





# Soil Erosion: Land Management Practices

**Climatic Conditions**  
(Wet / Dry Extremes)

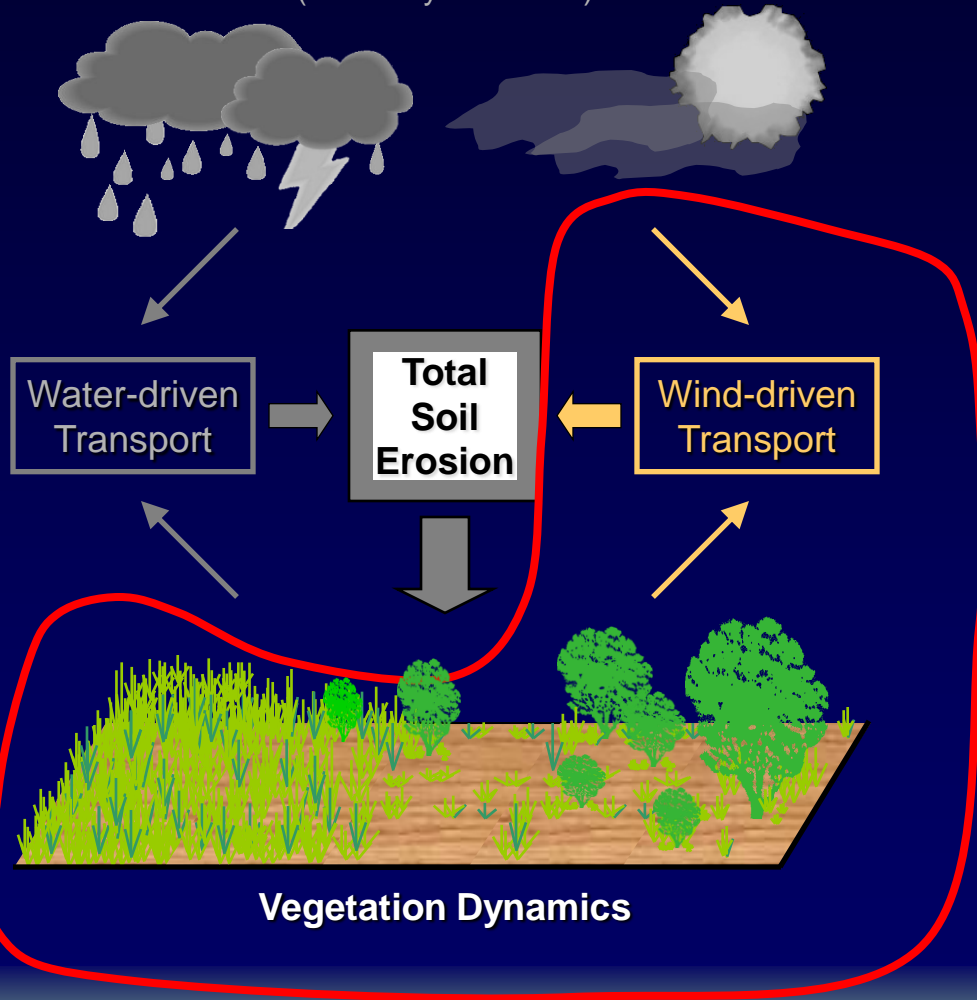


**Vegetation Dynamics**  
(Land Management Practices)



# Wind-driven Transport

**Climatic Conditions**  
(Wet / Dry Extremes)



# Climate Extremes

**Climatic Conditions**  
(Wet / Dry Extremes)



Water-driven  
Transport

**Total  
Soil  
Erosion**

Wind-driven  
Transport



**Vegetation Dynamics**  
(Land Management Practices)



# Land Management Practices

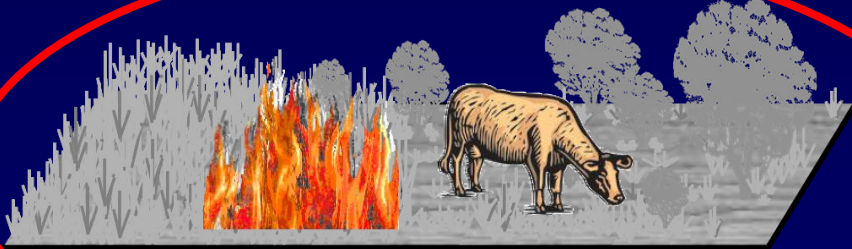
**Climatic Conditions**  
(Wet / Dry Extremes)



Water-driven  
Transport

**Total  
Soil  
Erosion**

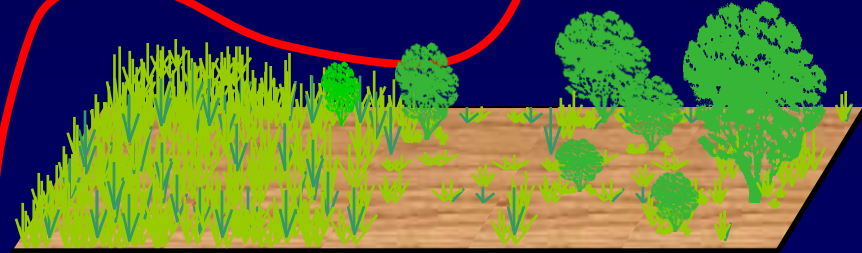
Wind-driven  
Transport



Land Management Practices

# Wind-driven Sediment Transport

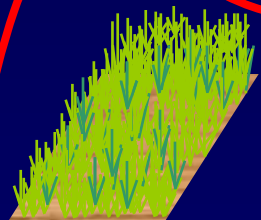
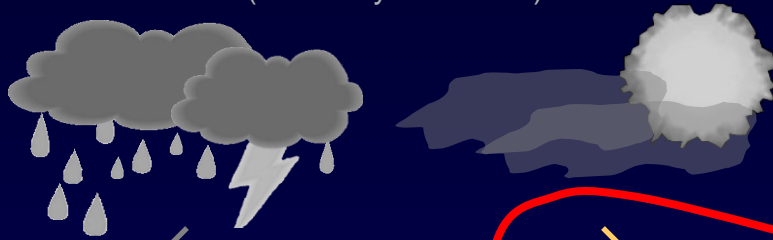
**Climatic Conditions**  
(Wet / Dry Extremes)



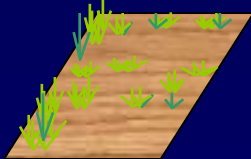
**Vegetation Dynamics**

# Wind-driven Sediment Transport

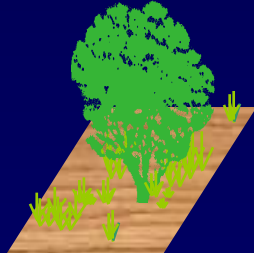
**Climatic Conditions**  
(Wet / Dry Extremes)



Herbaceous



Bare

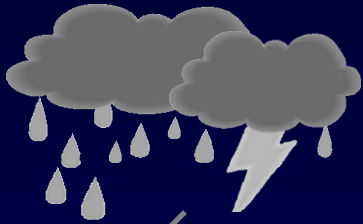


Shrub



# Wind-driven Sediment Transport

**Climatic Conditions**  
(Wet / Dry Extremes)



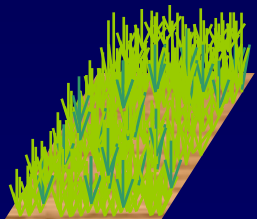
Water-driven  
Transport



**Total  
Soil  
Erosion**



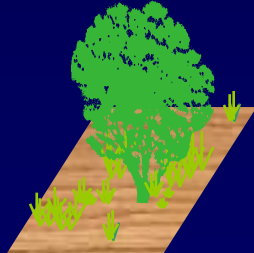
Wind-driven  
Transport



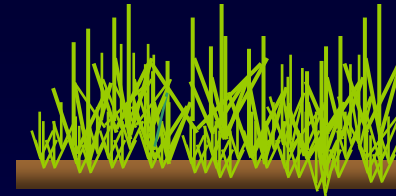
Herbaceous



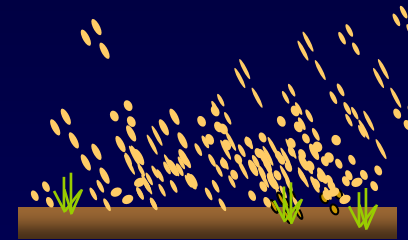
Bare



Shrub



Herbaceous



Bare



Shrub



# Wind-driven Sediment Transport

**Climatic Conditions**  
(Wet / Dry Extremes)



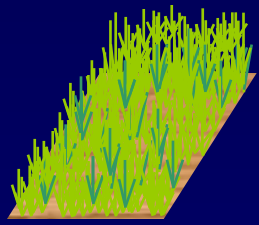
Water-driven  
Transport



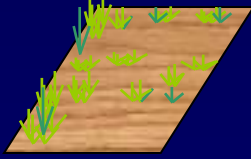
**Total  
Soil  
Erosion**



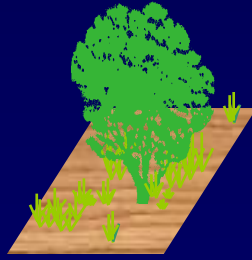
Wind-driven  
Transport



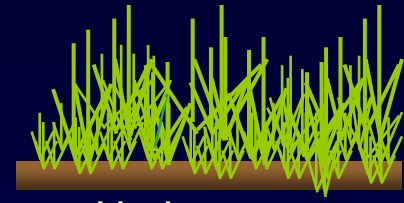
Herbaceous



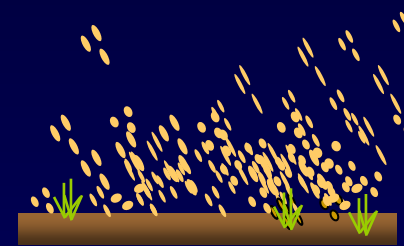
Bare



Shrub



Herbaceous



Bare





# Wind-driven Sediment Transport

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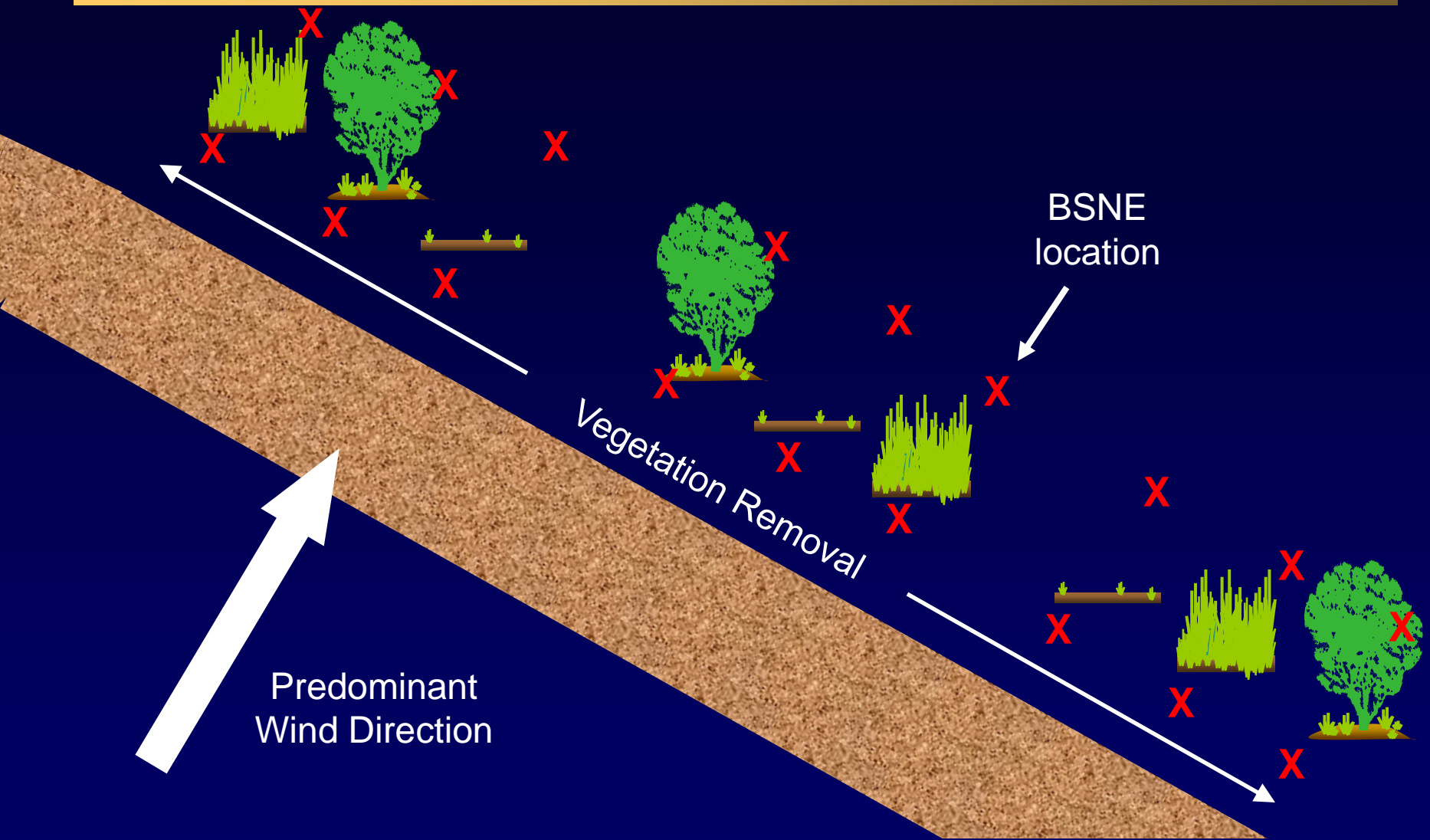


# Wind-driven Sediment Transport

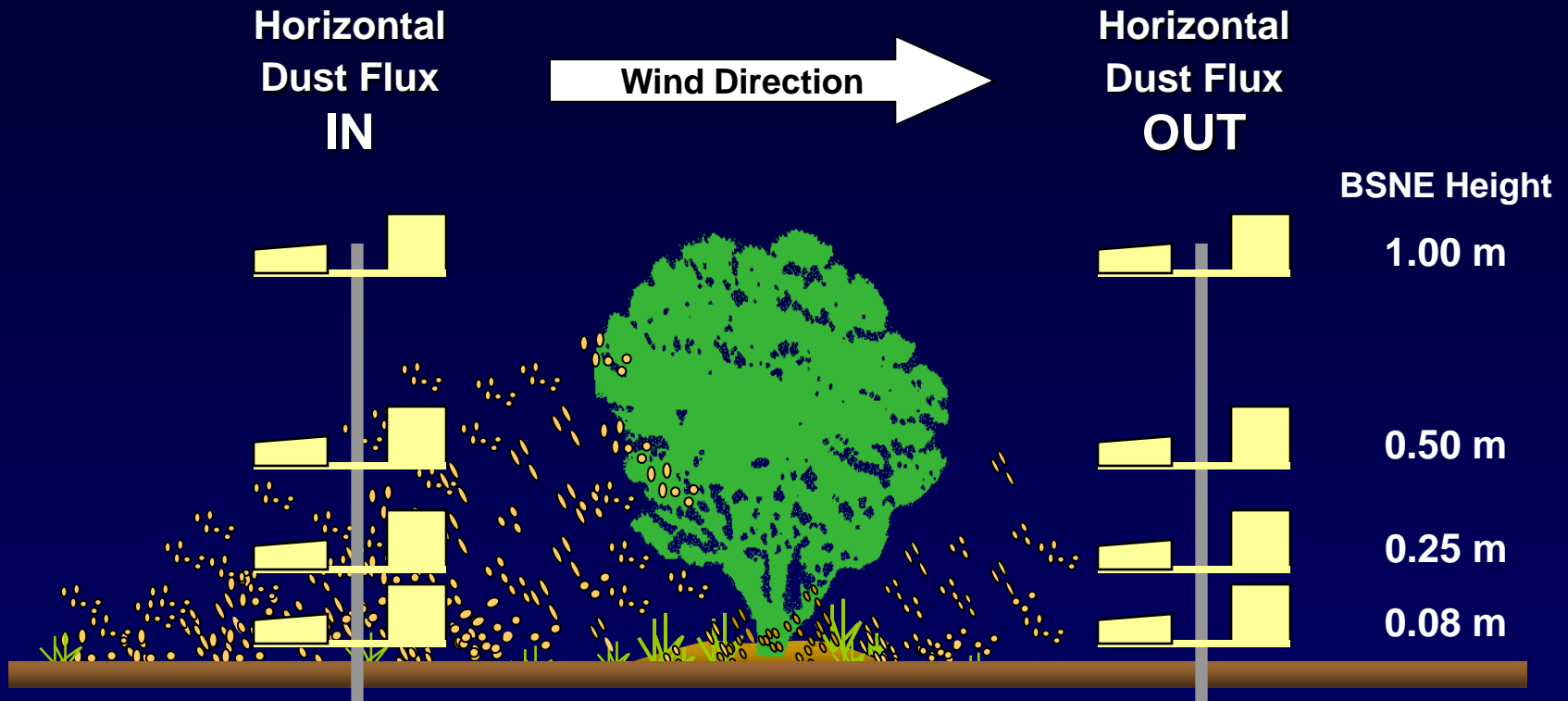
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# Dust Capture: Study Design

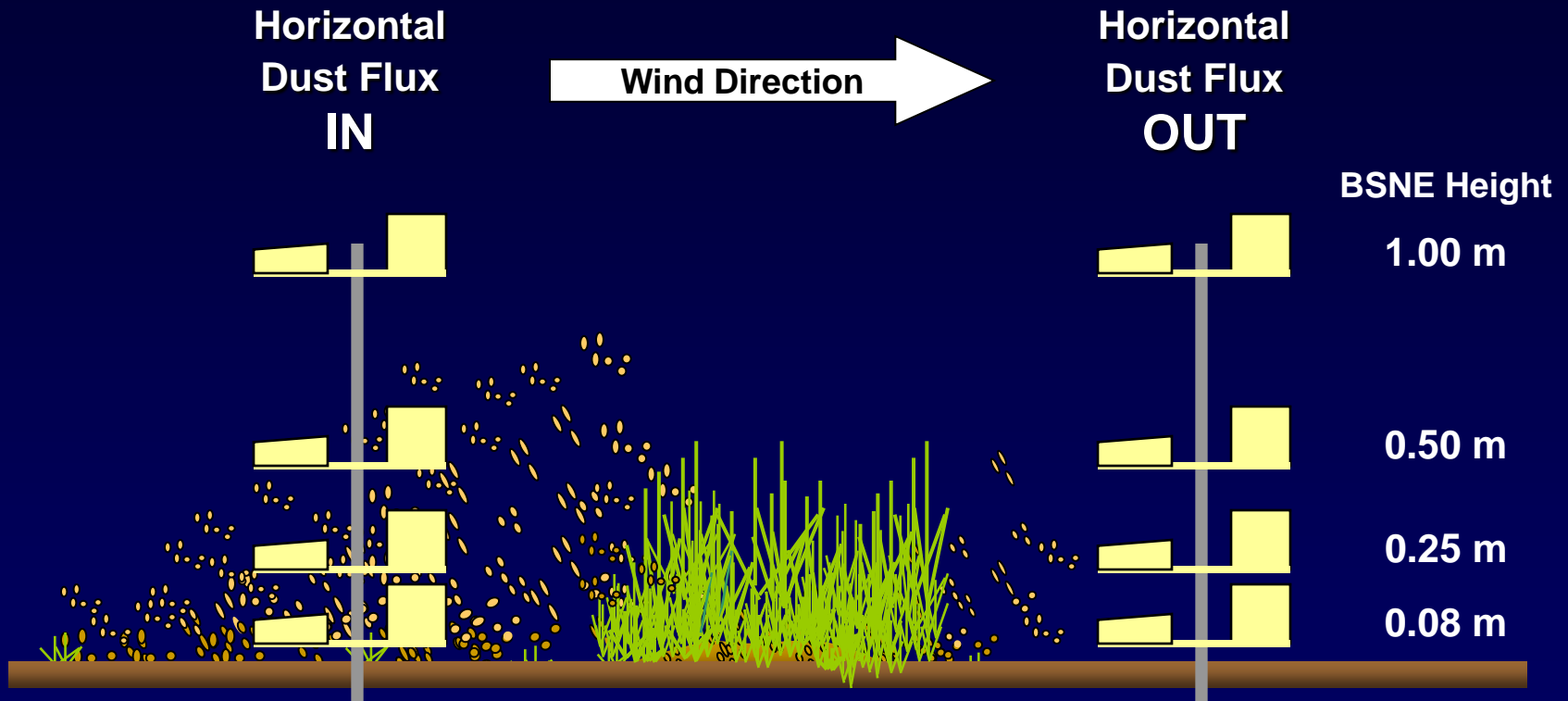


# Shrub-Dominated Patch

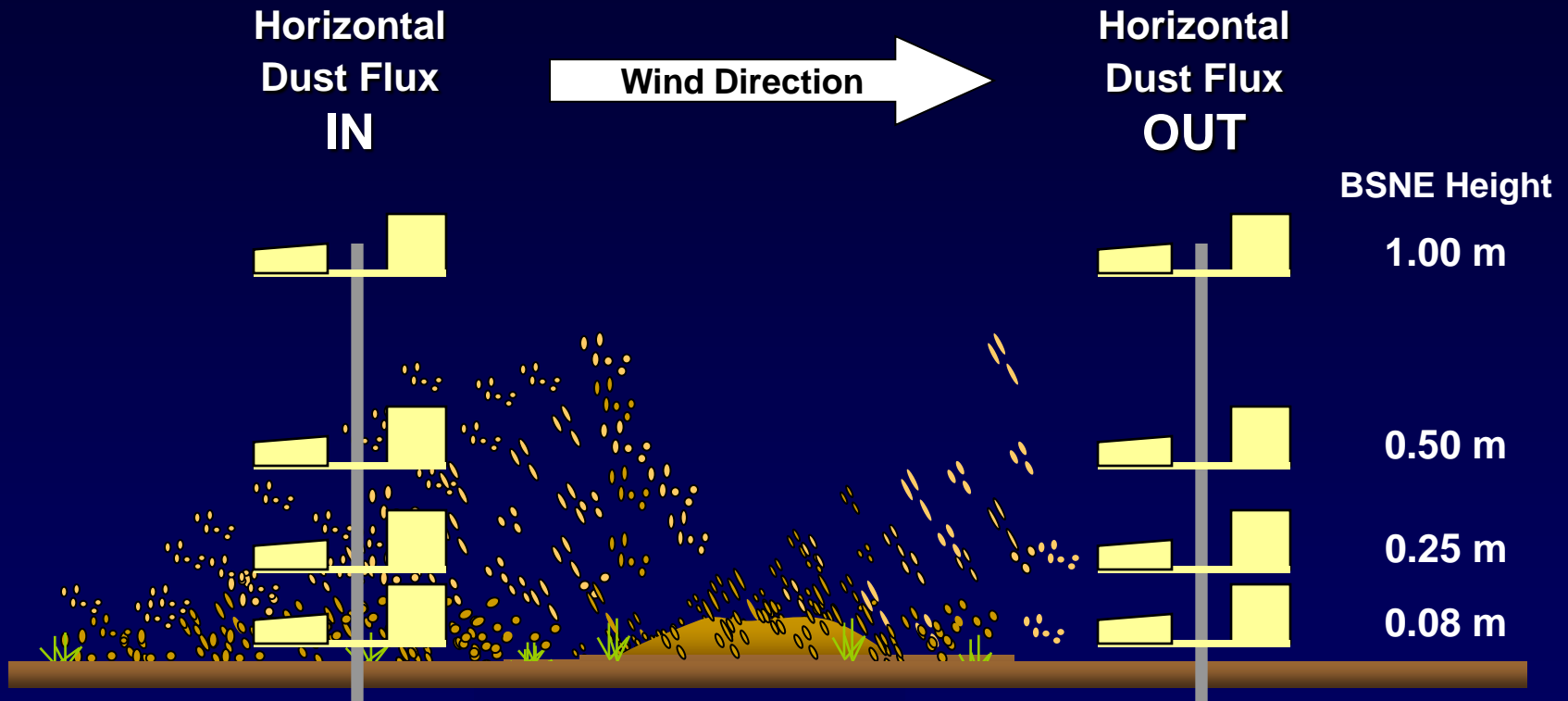




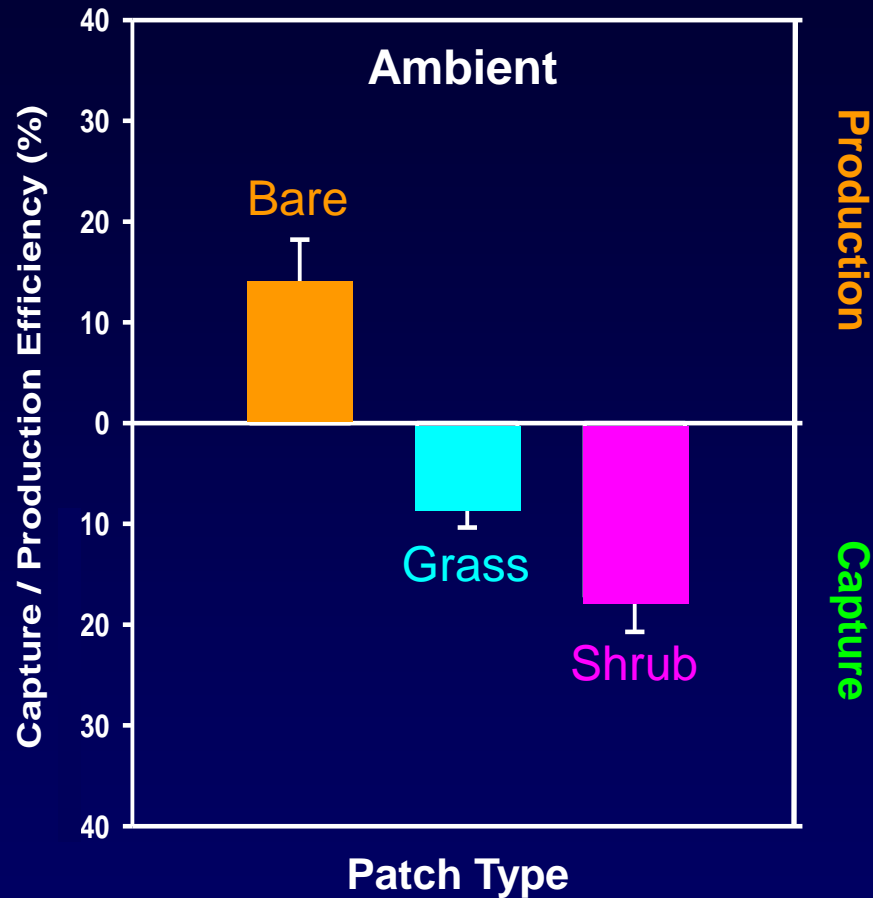
# Herbaceous Patch



## Bare Patch (<10% cover)

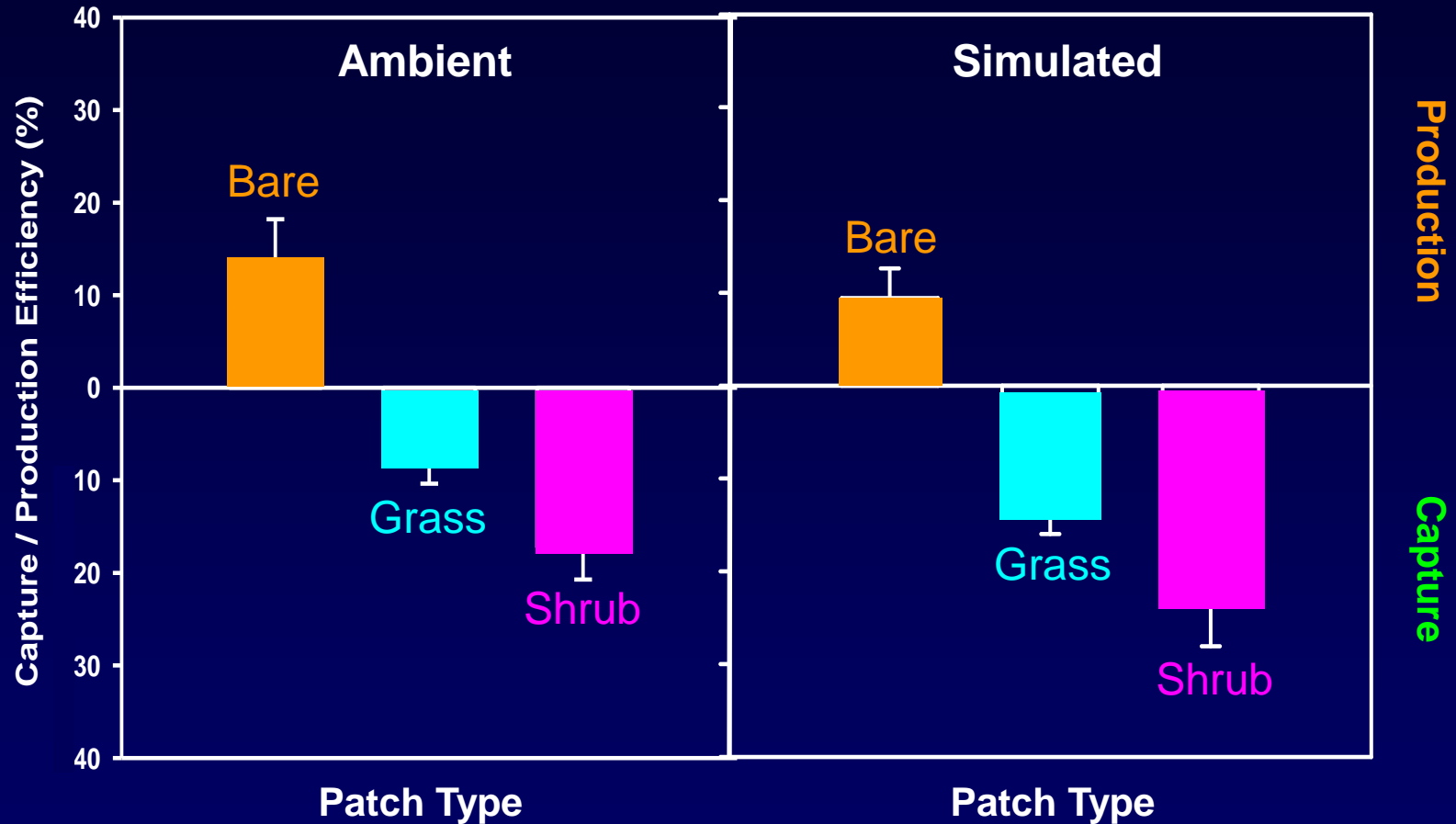


# Wind-driven Sediment Transport



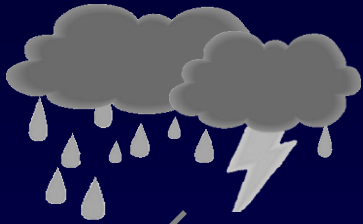


# Wind-driven Sediment Transport



# Effects of Disturbance

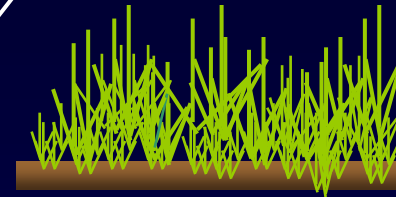
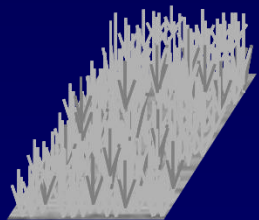
**Climatic Conditions**  
(Wet / Dry Extremes)



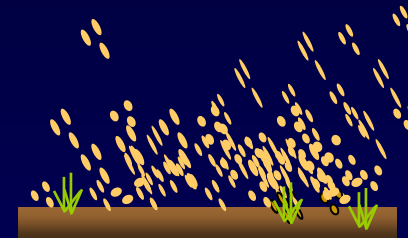
Water-driven  
Transport

**Total  
Soil  
Erosion**

Wind-driven  
Transport



Herbaceous



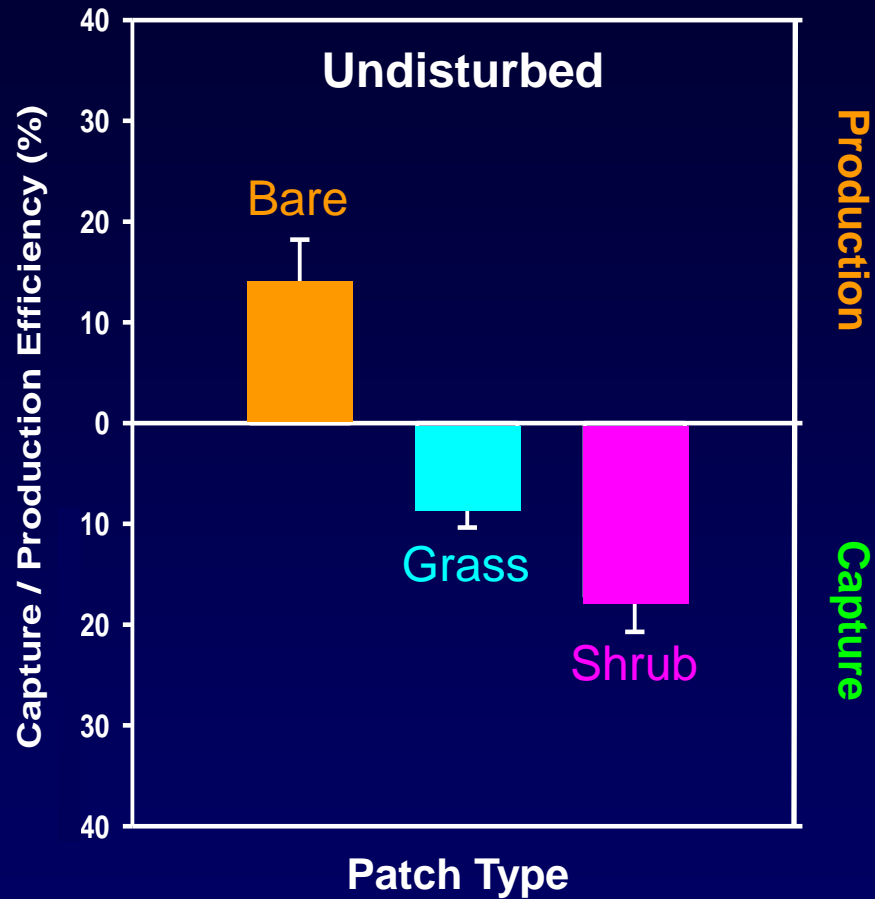
Bare



Shrub

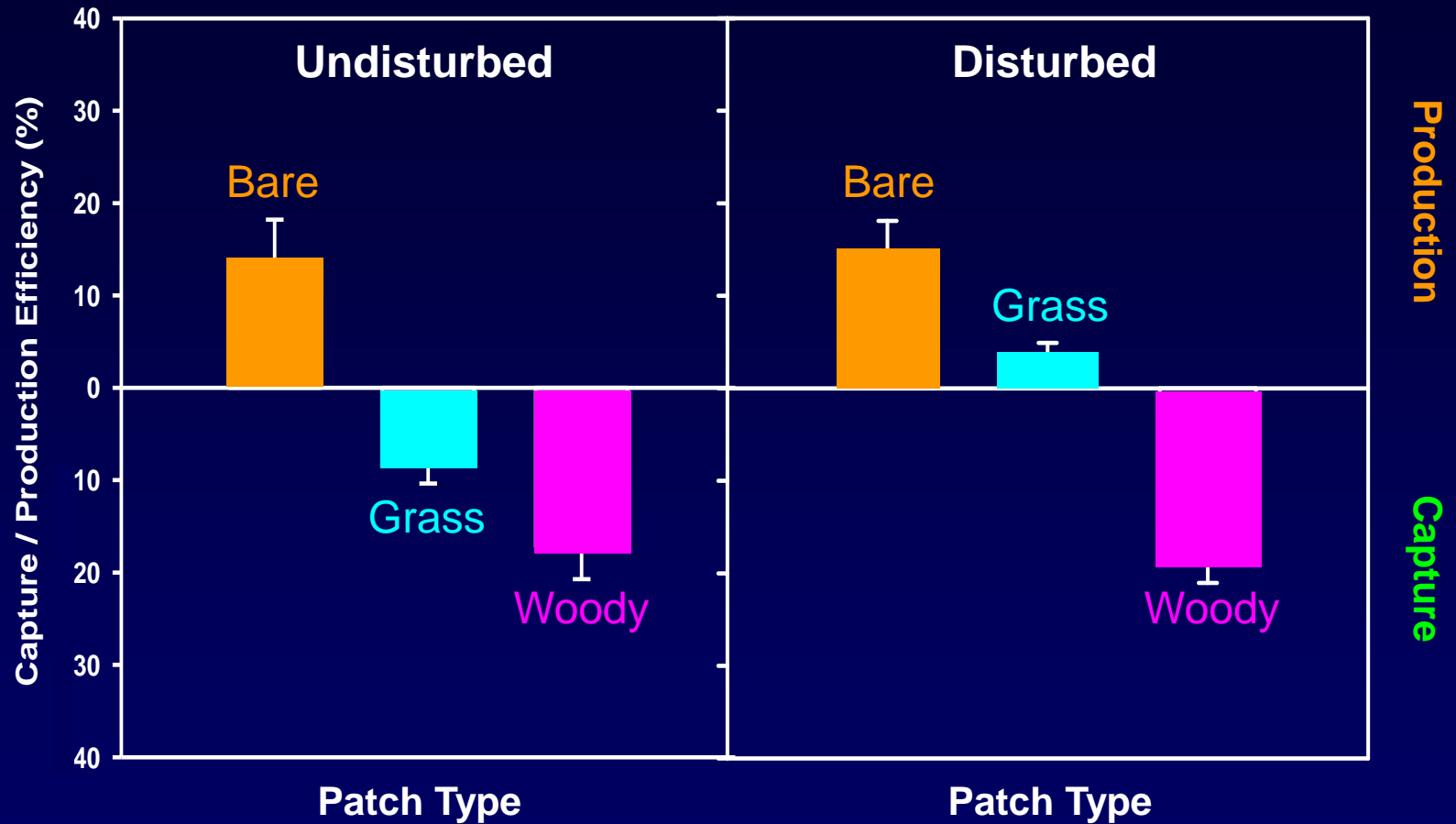
Herbaceous      Bare      Shrub  
(Land Management Practices)

# Effects of Disturbance

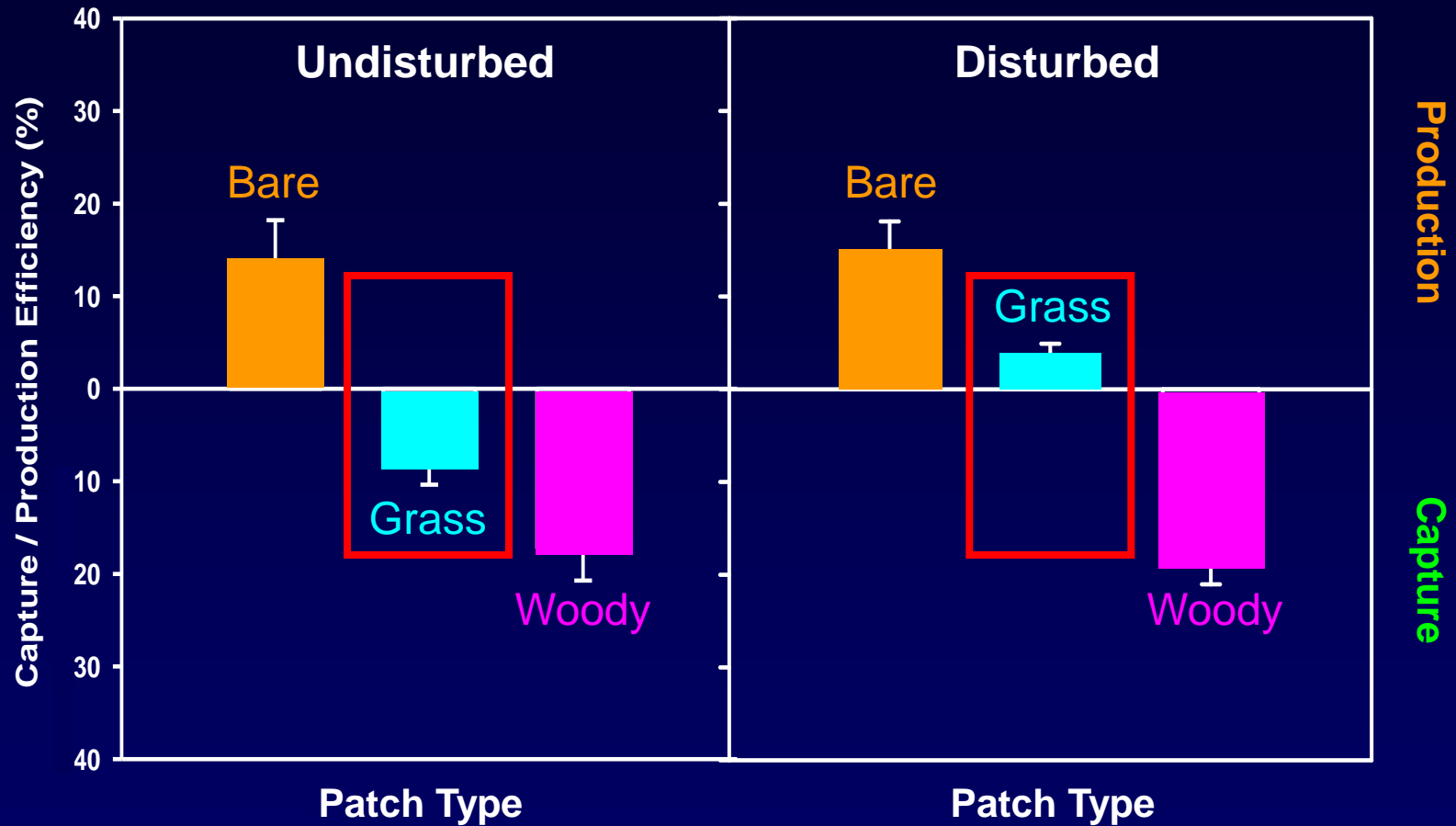




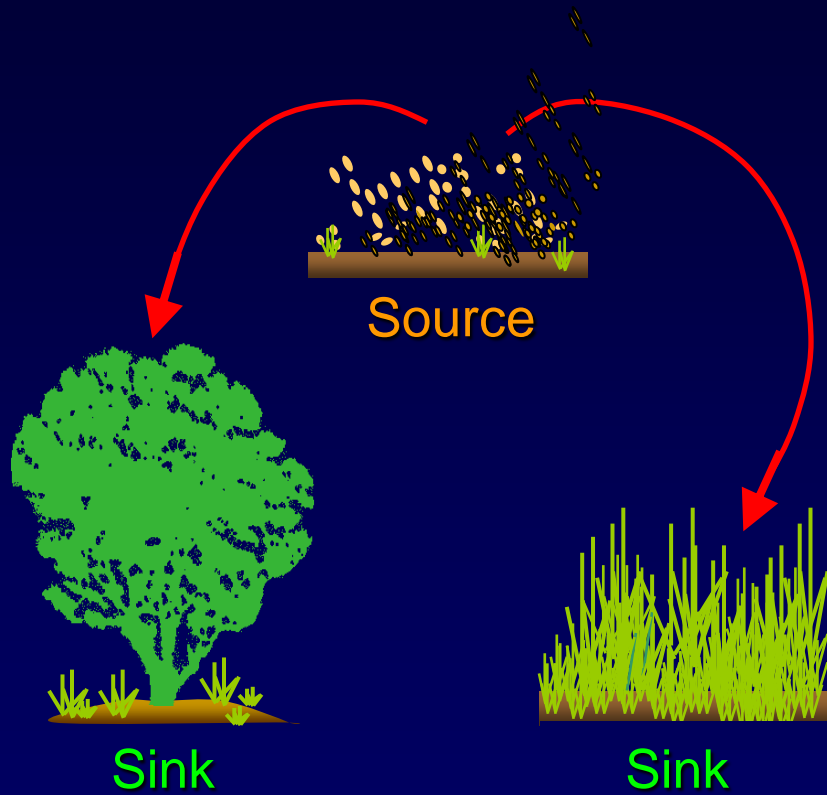
# Effects of Disturbance



# Effects of Disturbance

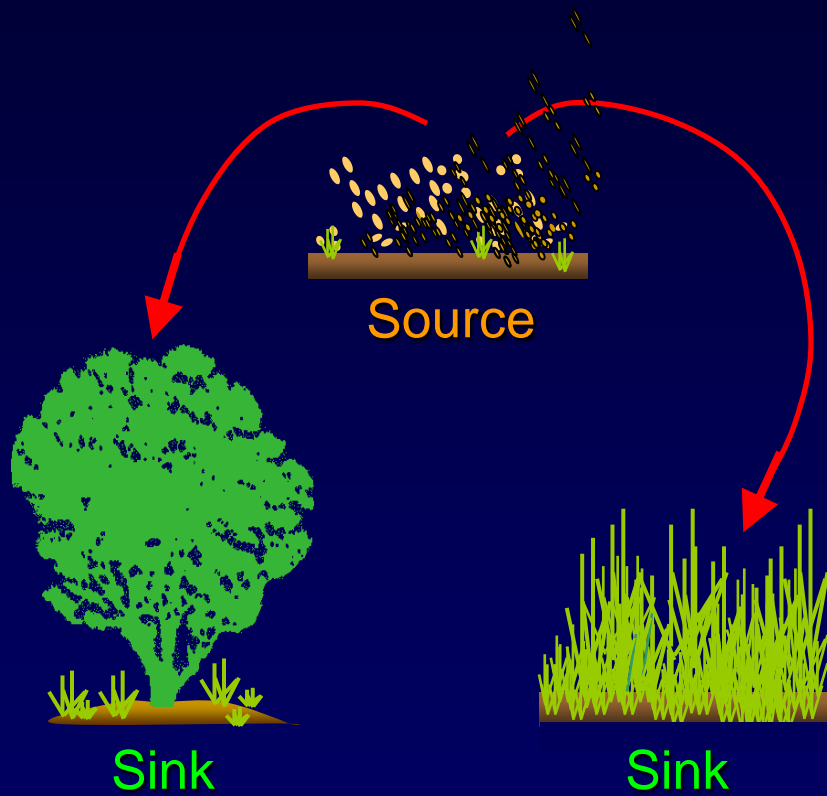


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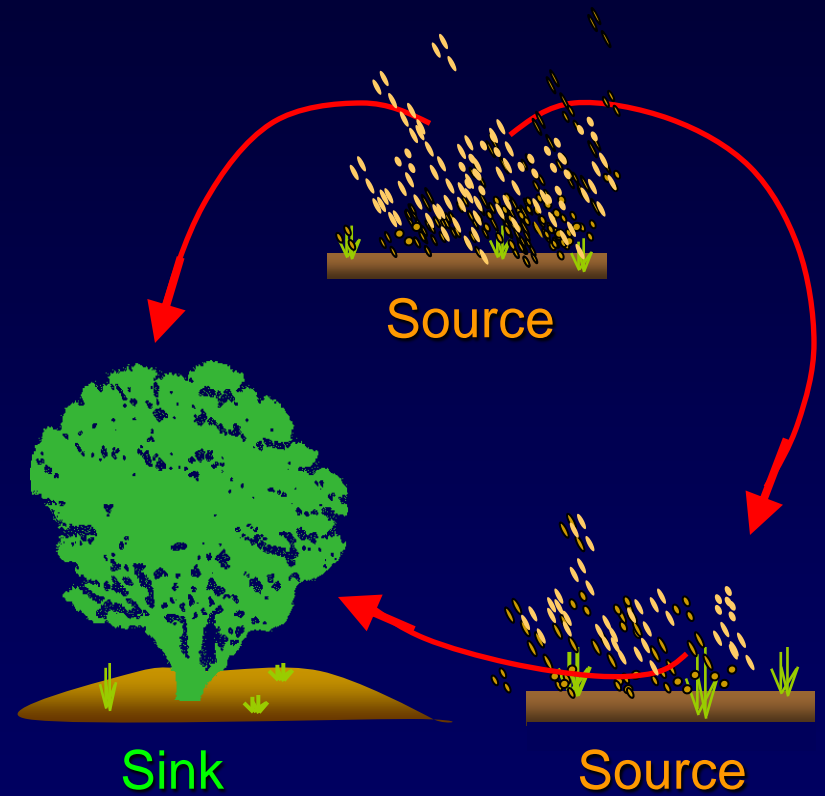




## Undisturbed

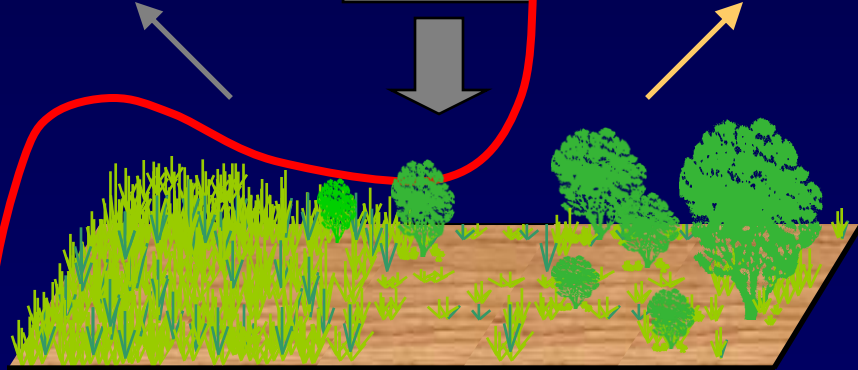


## Disturbed



# Wind-driven Sediment Transport

**Climatic Conditions**  
(Wet / Dry Extremes)



**Vegetation Dynamics**

# Climate Extremes

**Climatic Conditions**  
(Wet / Dry Extremes)



Water-driven  
Transport

**Total  
Soil  
Erosion**

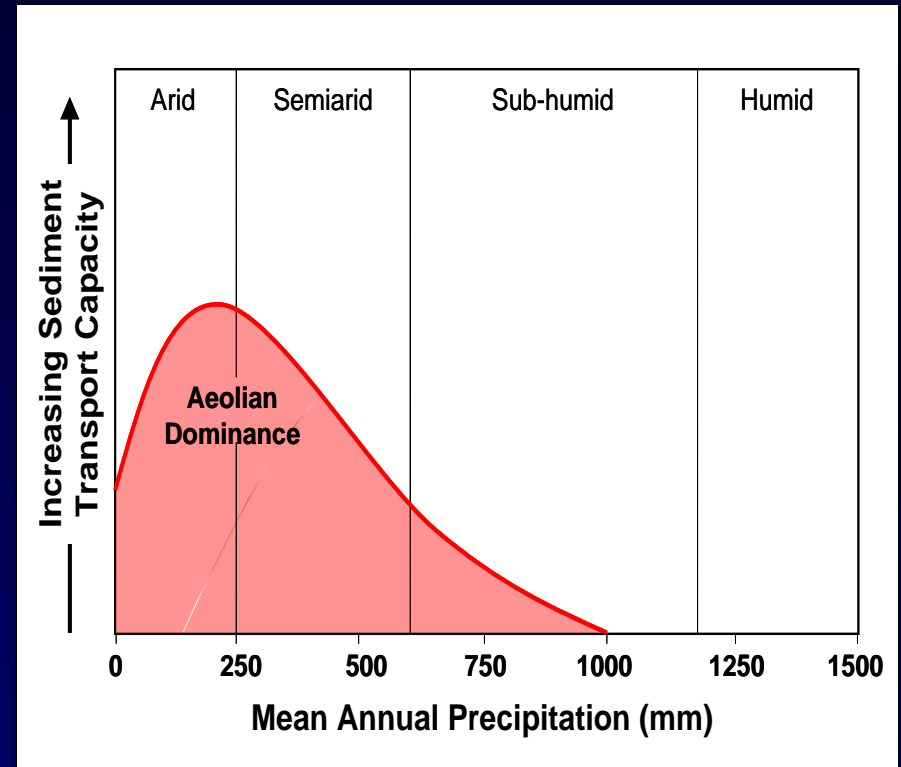
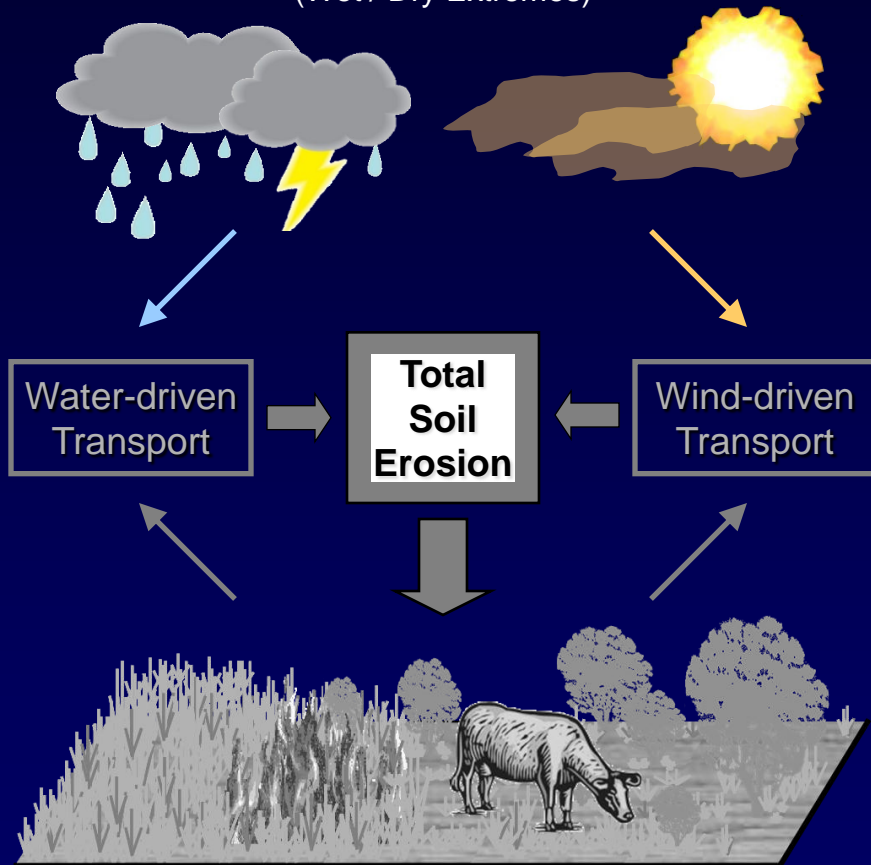
Wind-driven  
Transport



**Vegetation Dynamics**  
(Land Management Practices)

# Climate Extremes

## Climatic Conditions (Wet / Dry Extremes)

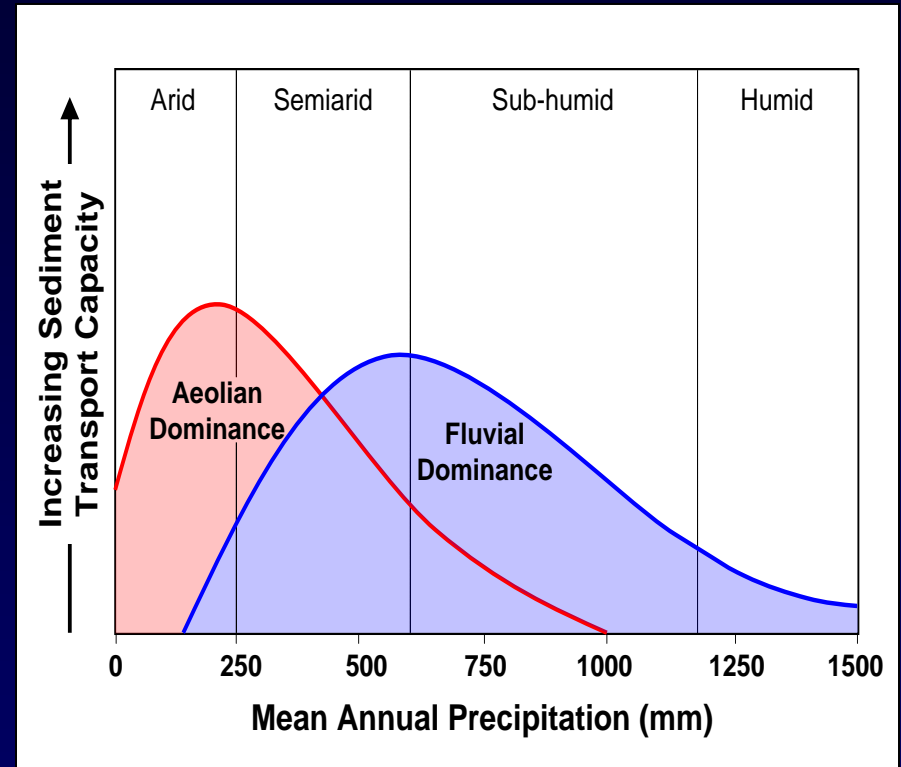
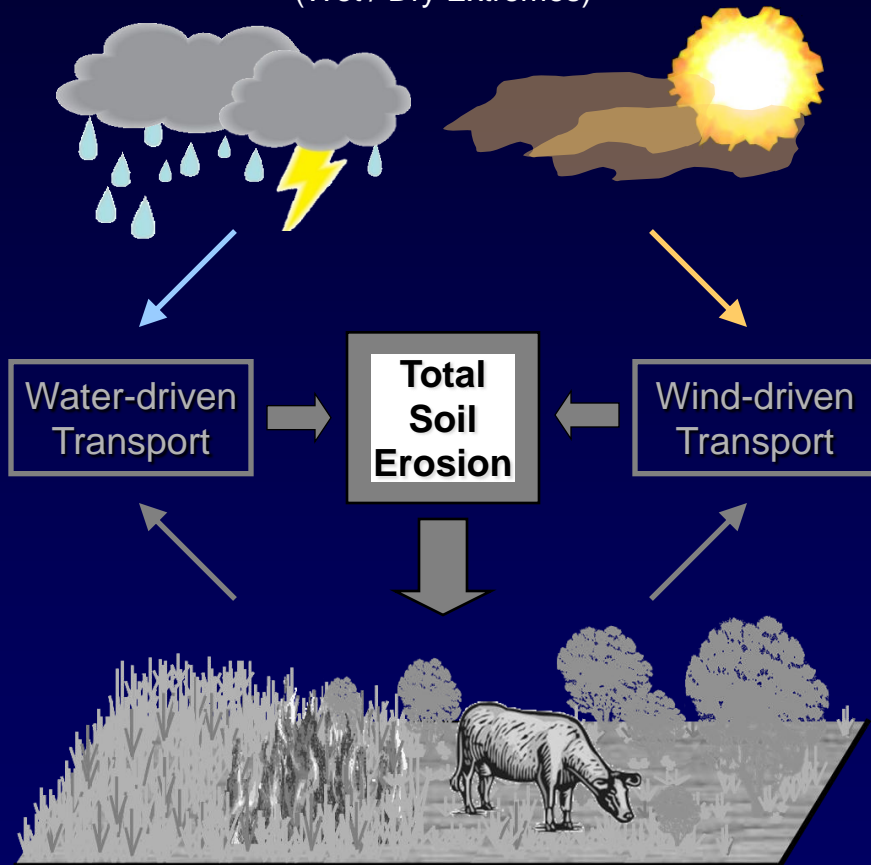


Field et al. (2009) Aeolian Research



# Climate Extremes

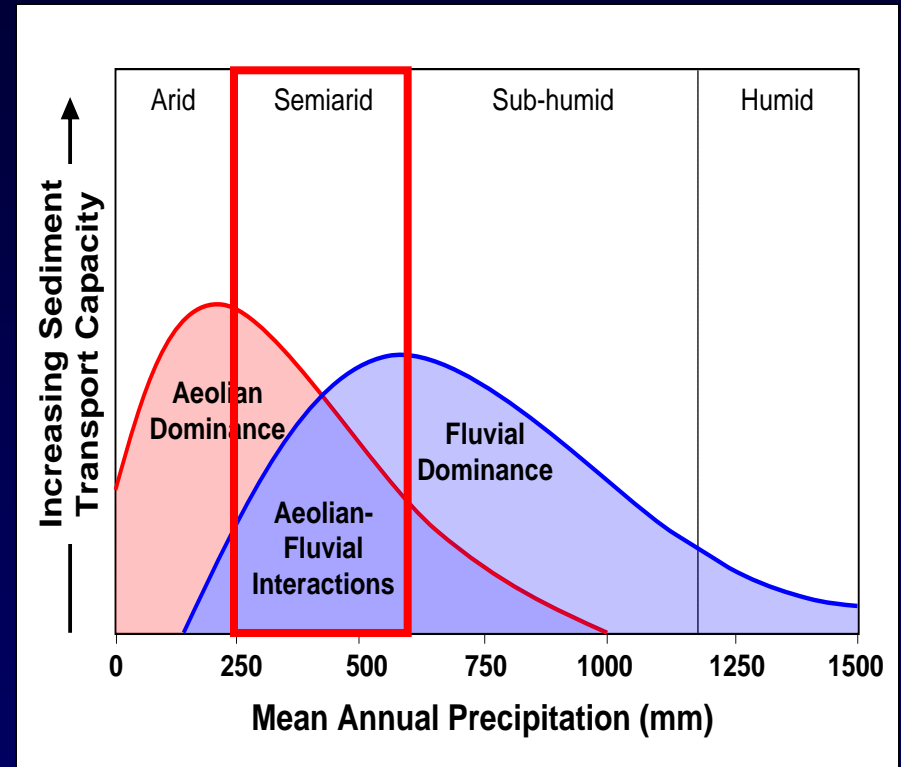
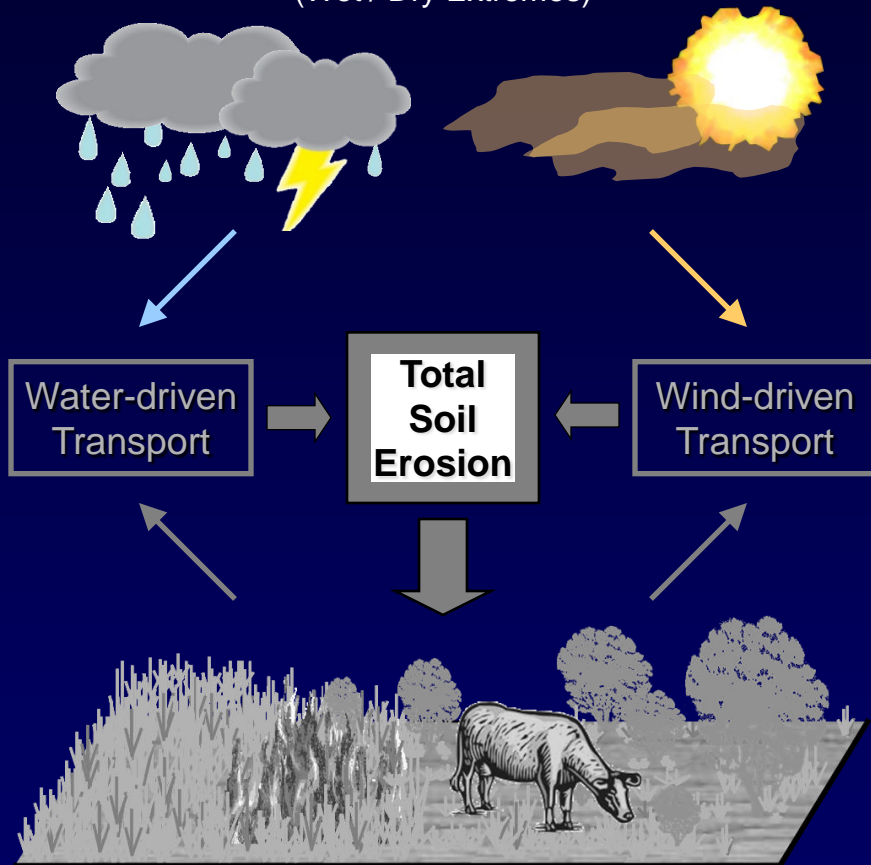
## Climatic Conditions (Wet / Dry Extremes)



Field et al. (2009) Aeolian Research

# Climate Extremes

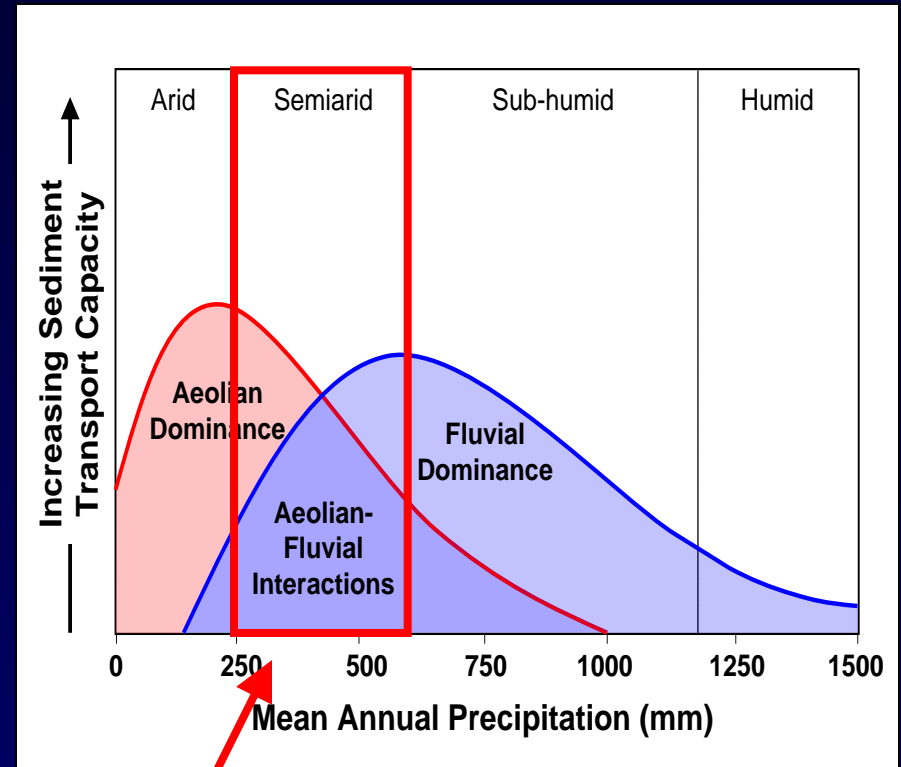
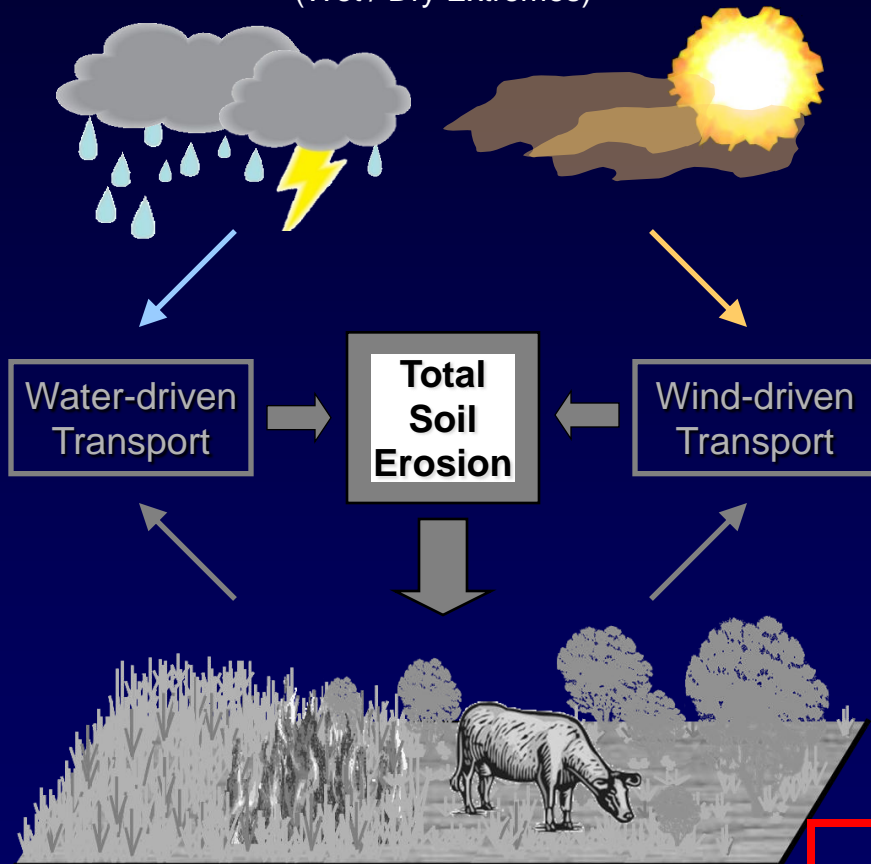
## Climatic Conditions (Wet / Dry Extremes)



Field et al. (2009) Aeolian Research

# Climate Extremes

**Climatic Conditions**  
(Wet / Dry Extremes)

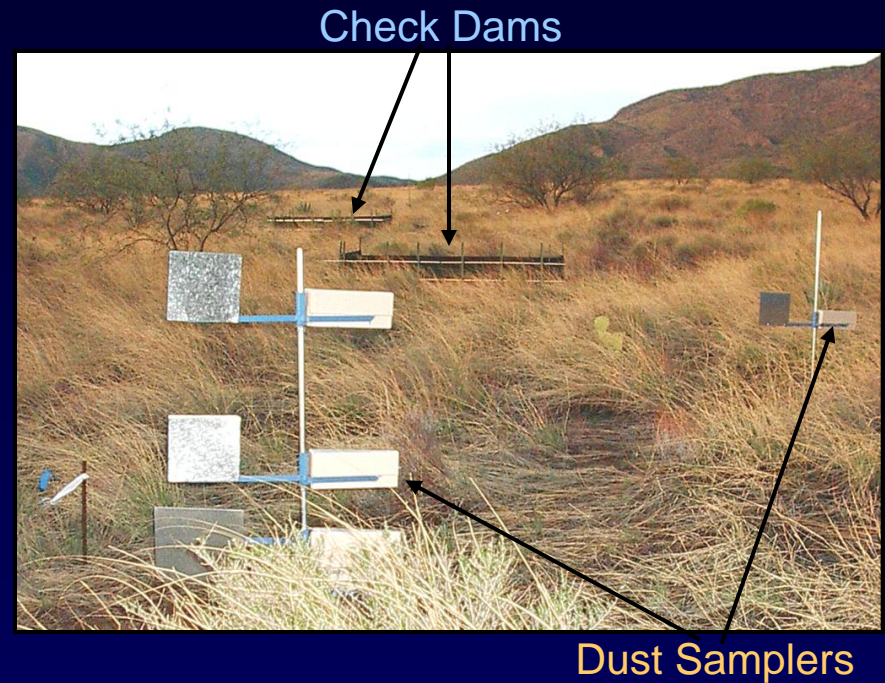


Field et al. (2009) Aeolian Research

**SRER  
Study Site**

# SRER Study Site

- 3 study plots (50 x 50 m)
- Each plot contained:
  - Six self-orienting dust samplers
  - A pair of sediment check dams (bordered 3 x 10 m and non-bordered)





# SERE Study Site

- 3 study plots (50 x 50 m)
- Each plot contained:
  - Six self-orienting dust samplers
  - A pair of sediment check dams (bordered 3 x 10 m and non-bordered)

BSNE samplers



Sediment Check Dam



# SERE Study Site

- 3 study plots (50 x 50 m)
- Each plot contained:
  - Six self-orienting dust samplers
  - A pair of sediment check dams (bordered 3 x 10 m and non-bordered)

## BSNE samplers



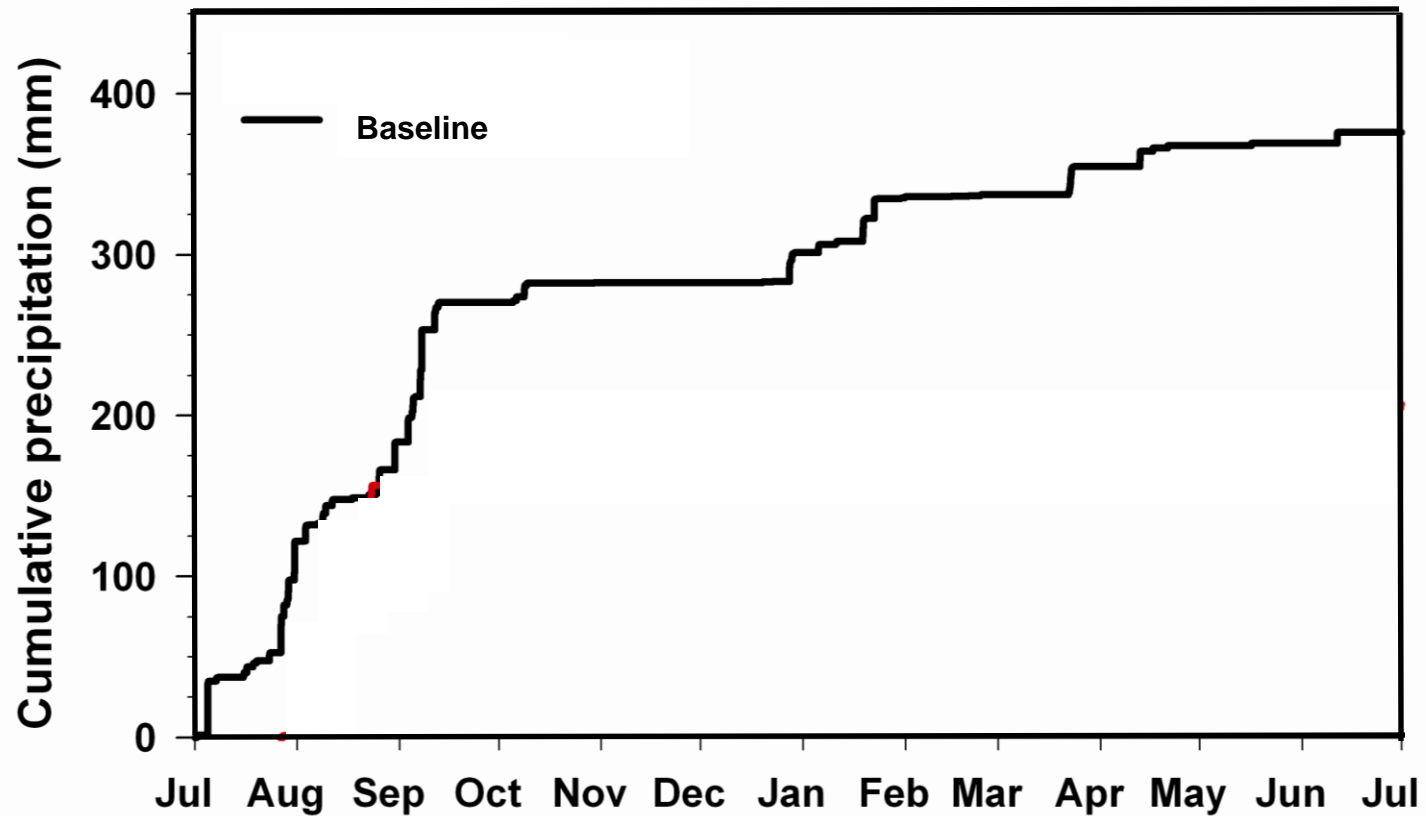
- Sediment collection:
  - Sample collection every 7 – 14 days
  - Sediment oven-dried at 60°C



## Sediment Check Dam

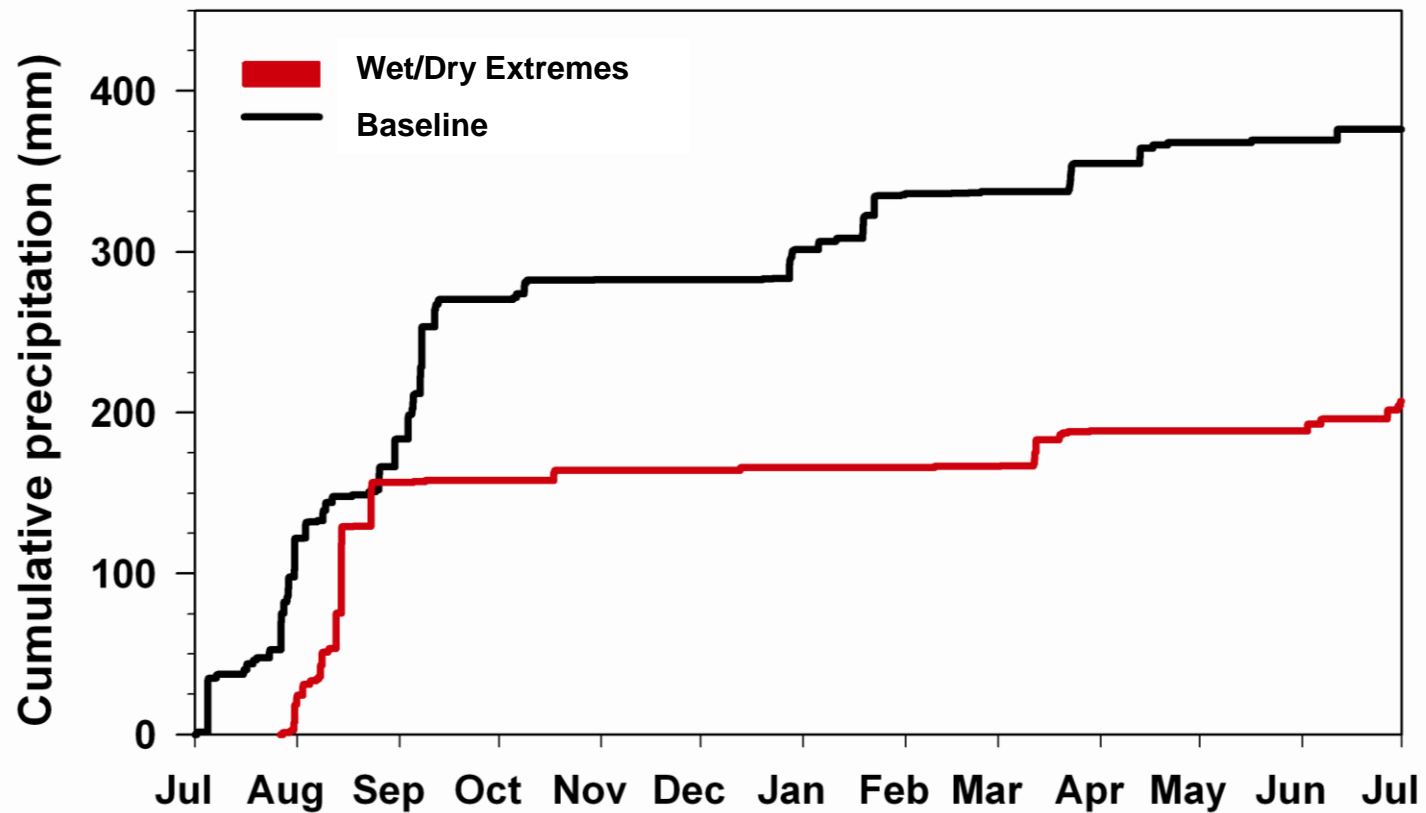


# Climate Extremes



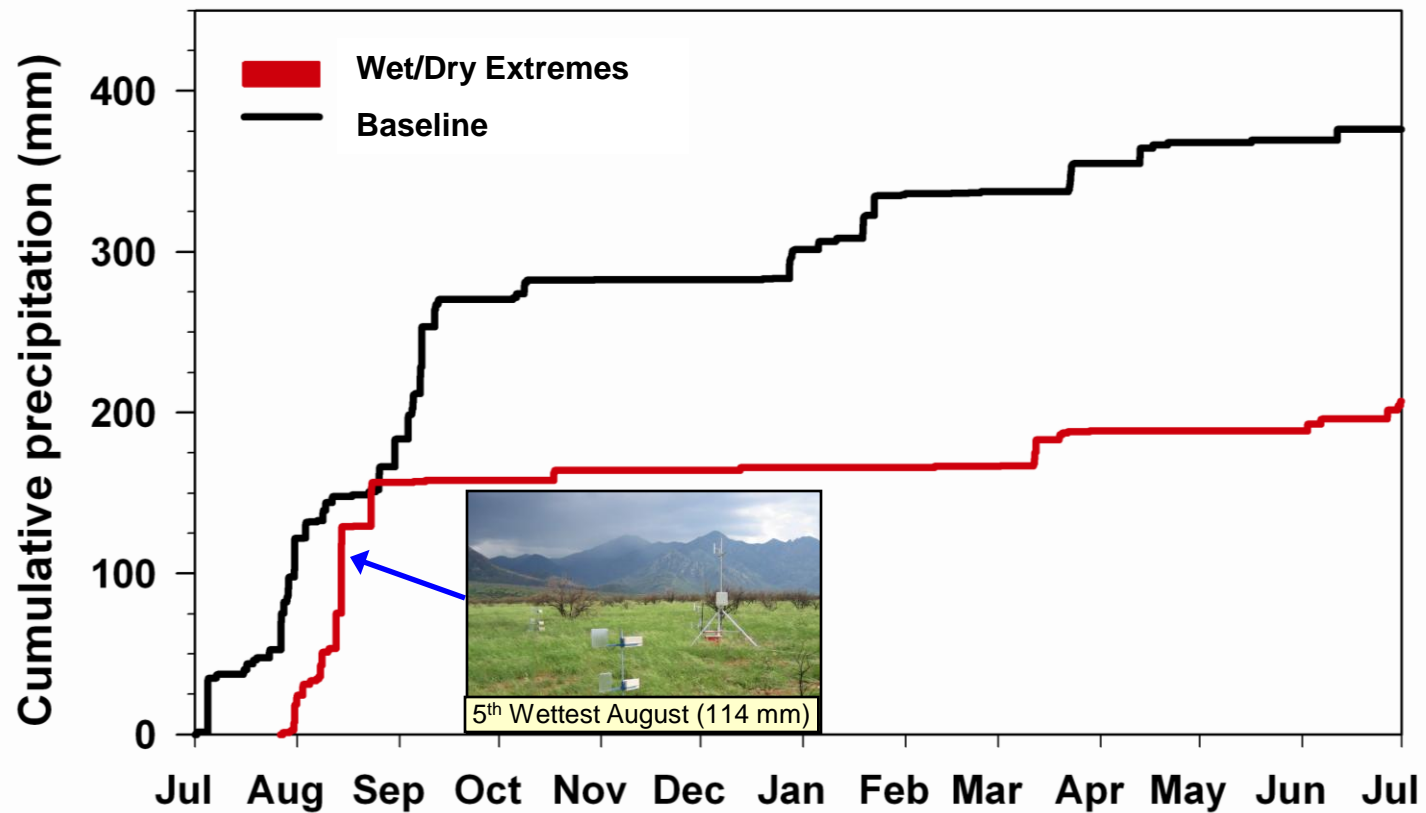


# Climate Extremes

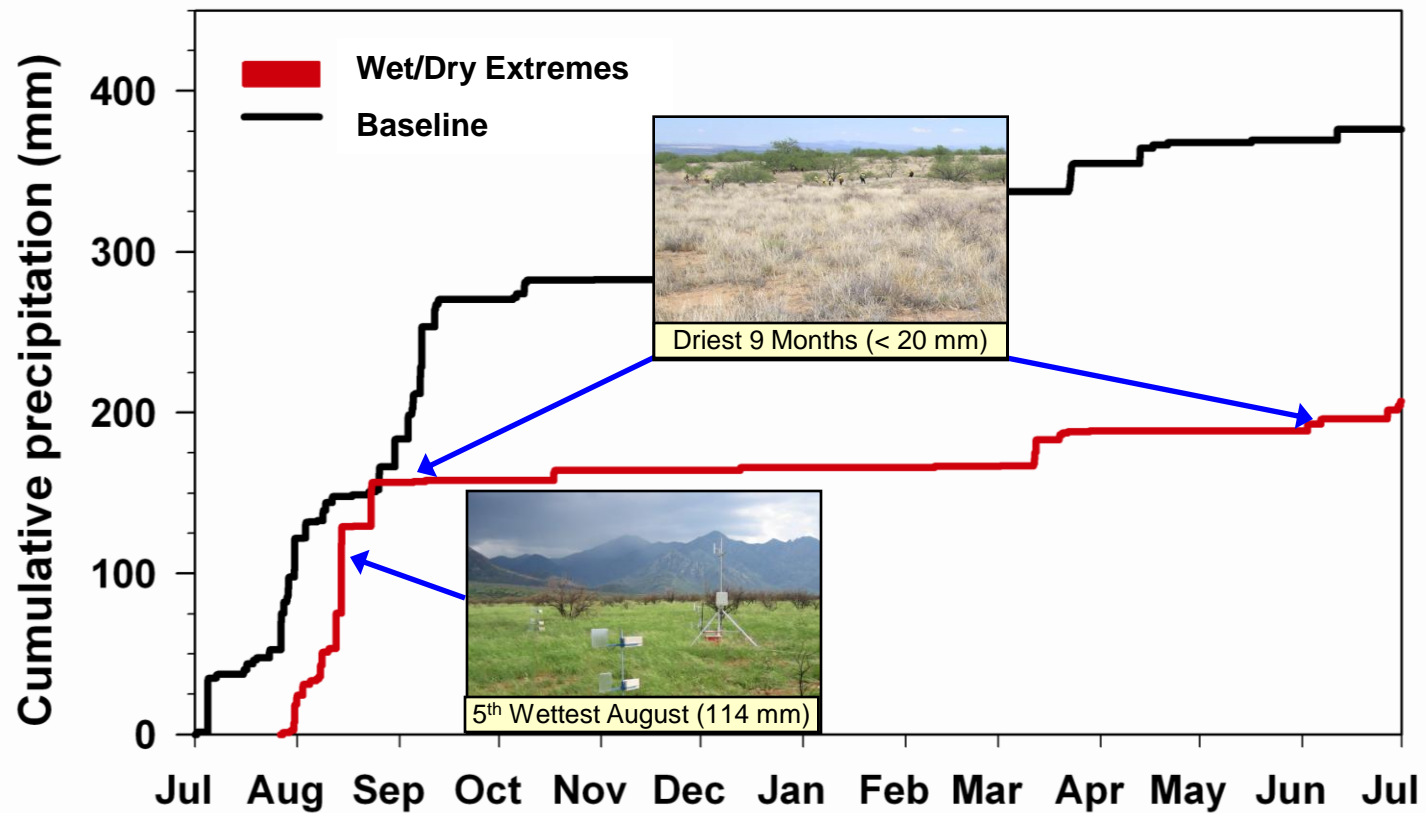




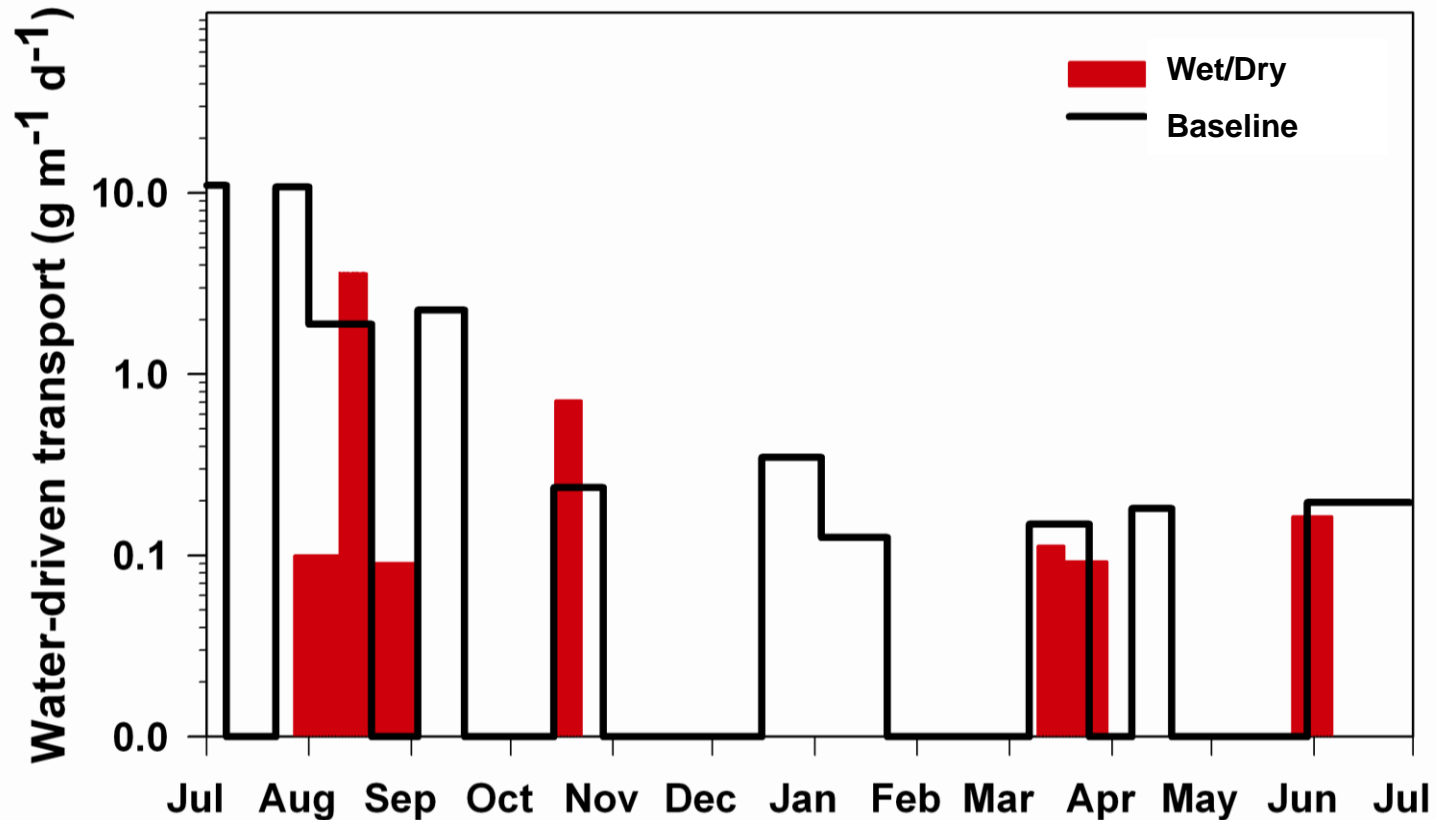
# Climate Extremes



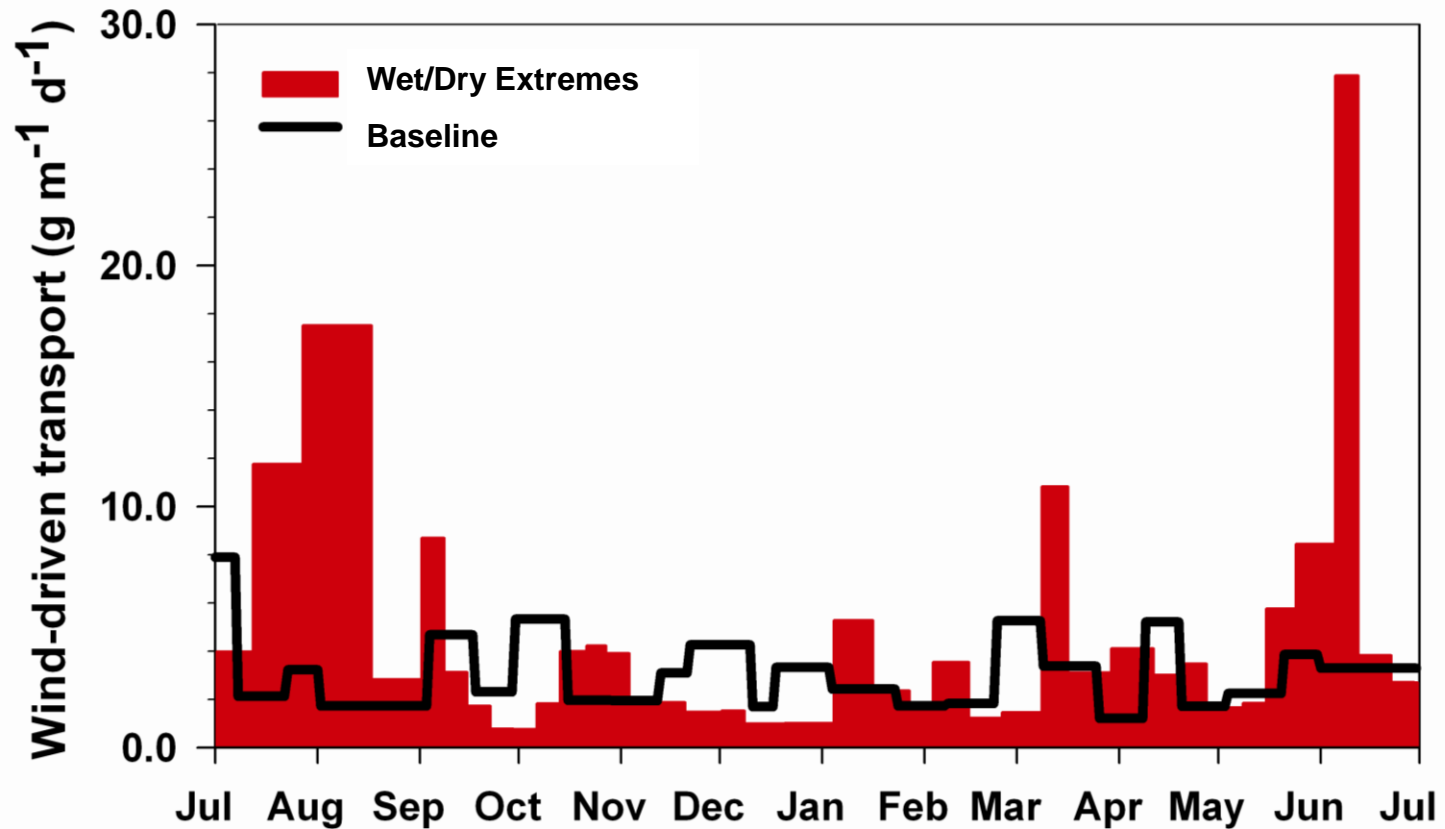
# Climate Extremes



# Water-driven Transport: Climate Extremes

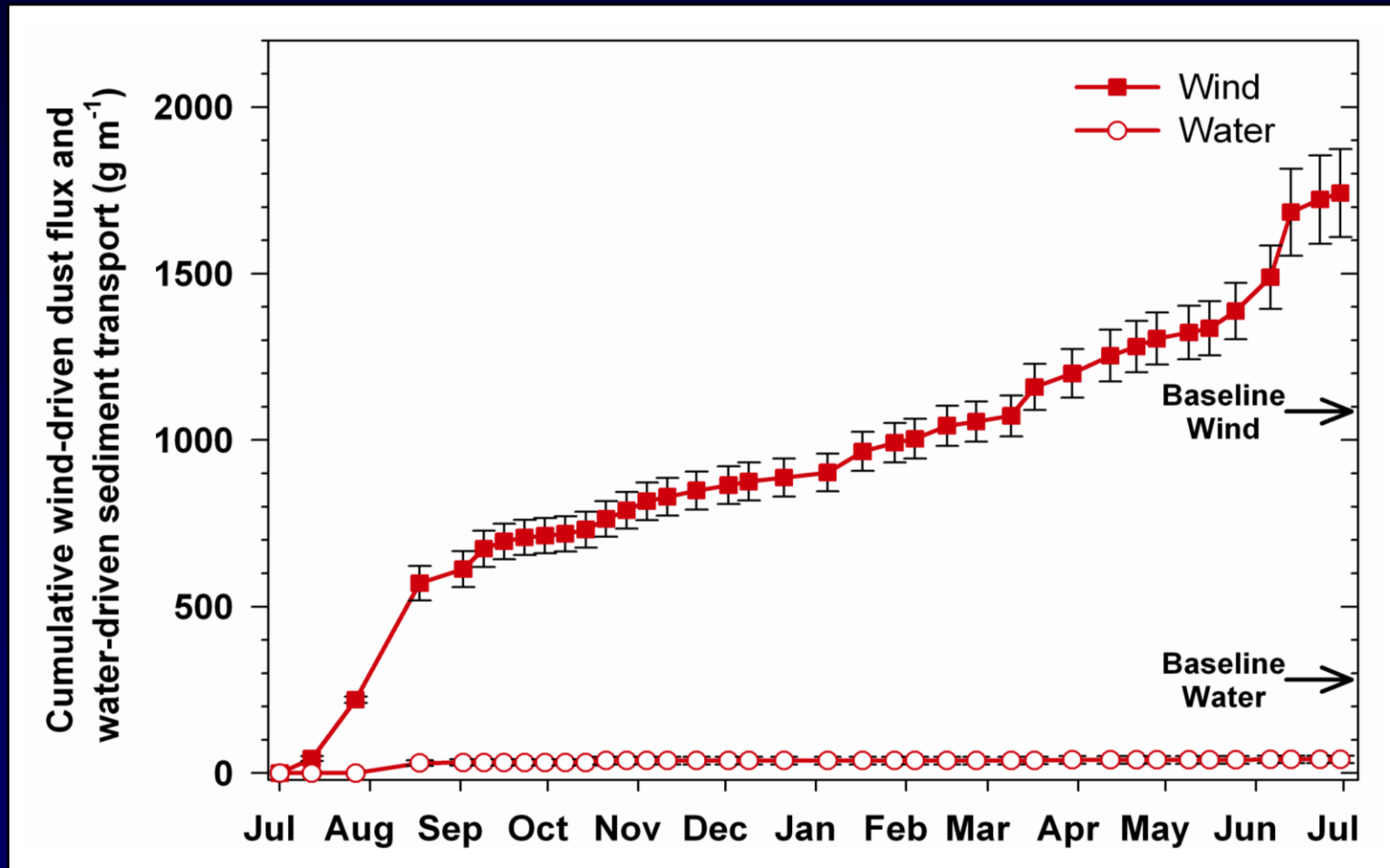


# Wind-driven Transport: Climate Extremes



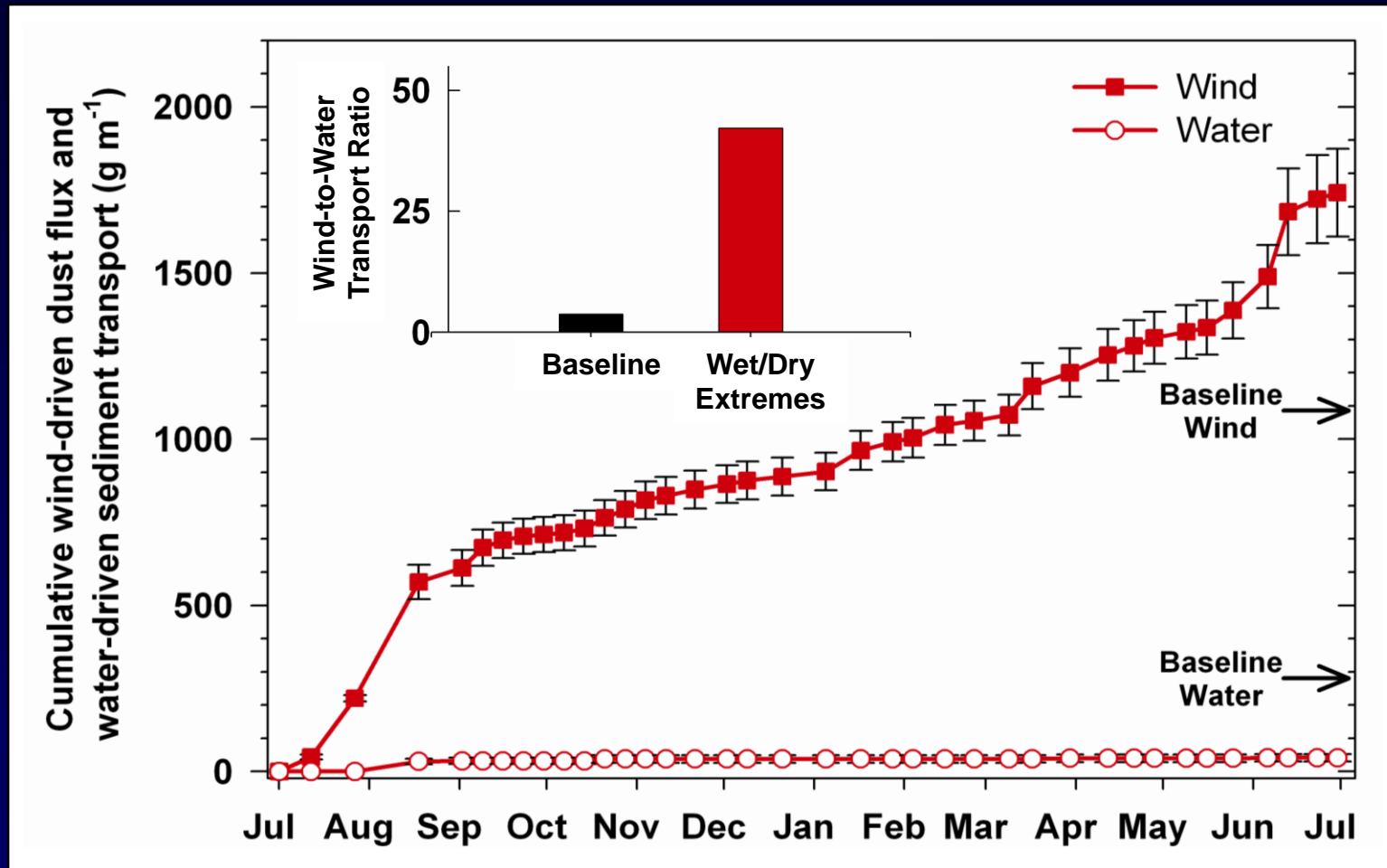


# Climate Extremes



Field et al. (2011) J Soil & Water Conservation

# Climate Extremes



Field et al. (2011) J Soil & Water Conservation

# Climate Extremes

**Climatic Conditions**  
(Wet / Dry Extremes)



Water-driven  
Transport

**Total  
Soil  
Erosion**

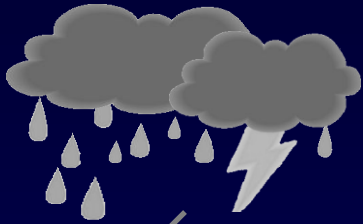
Wind-driven  
Transport



**Vegetation Dynamics**  
(Land Management Practices)

# Land Management Practices

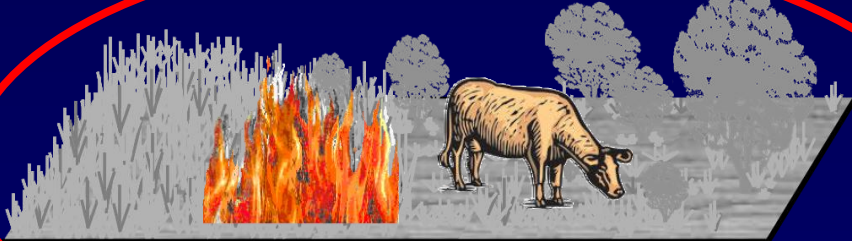
**Climatic Conditions**  
(Wet / Dry Extremes)



Water-driven  
Transport

**Total  
Soil  
Erosion**

Wind-driven  
Transport



Land Management Practices



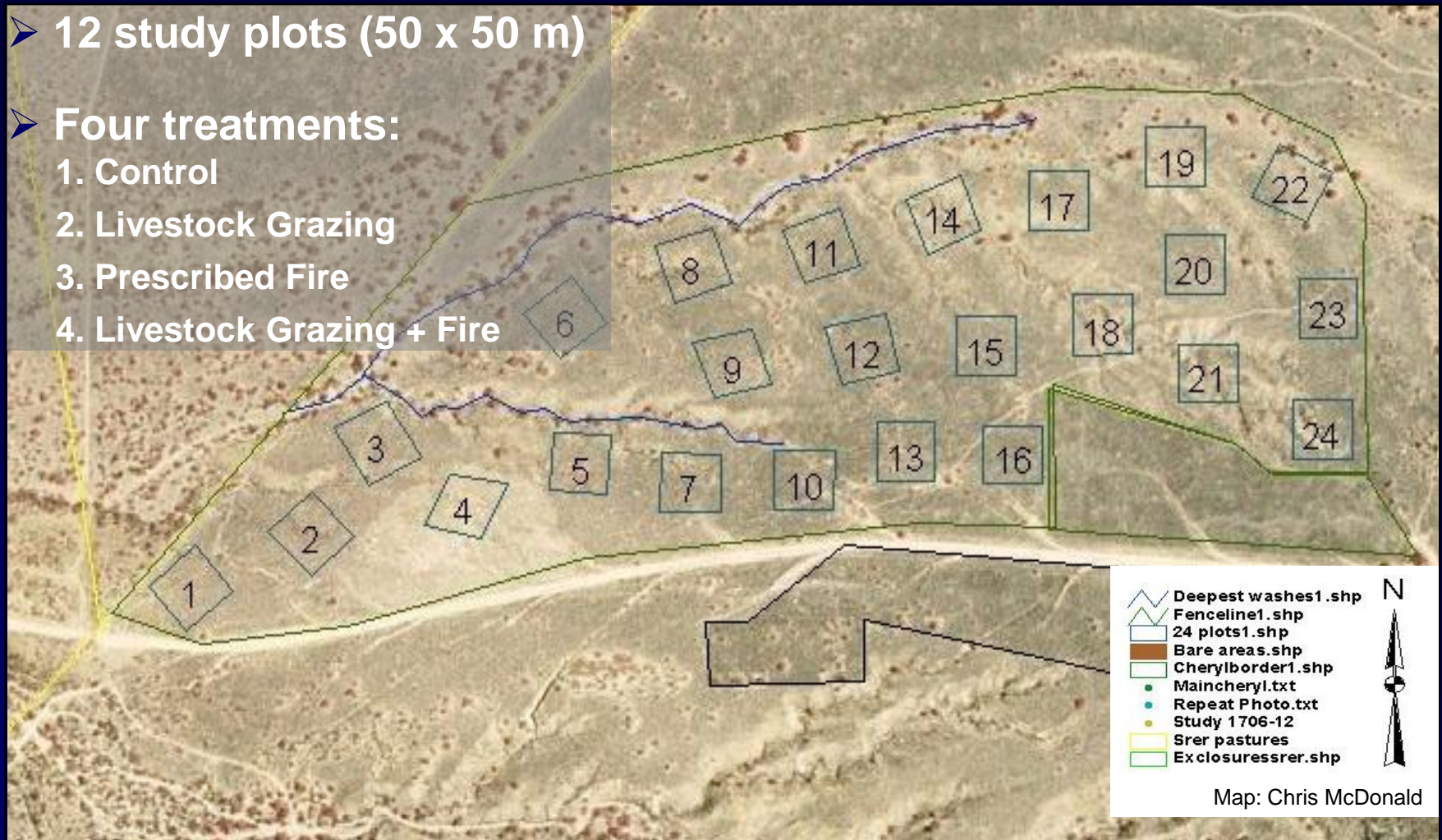


# Land Management Practices

➤ 12 study plots (50 x 50 m)

➤ Four treatments:

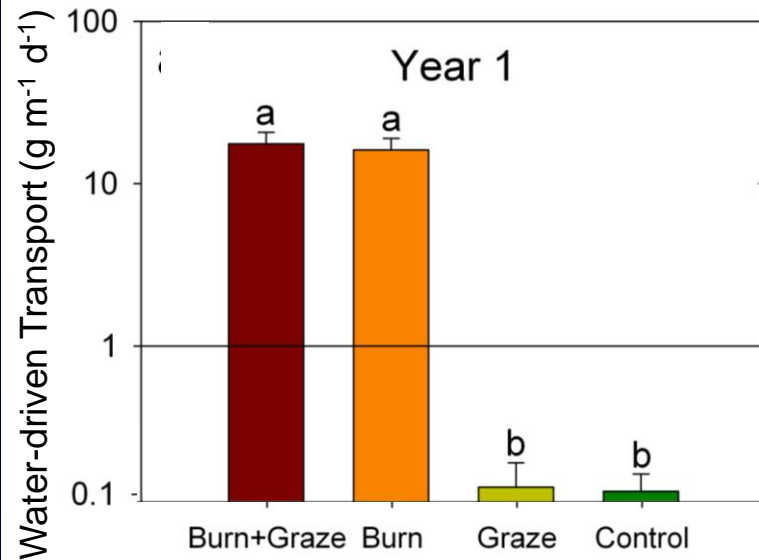
1. Control
2. Livestock Grazing
3. Prescribed Fire
4. Livestock Grazing + Fire



# Land Management Practices



## Water-driven Transport

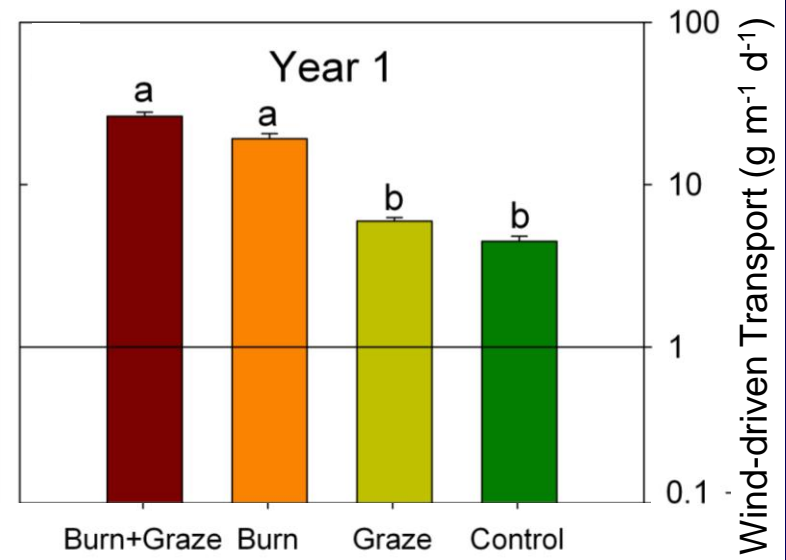
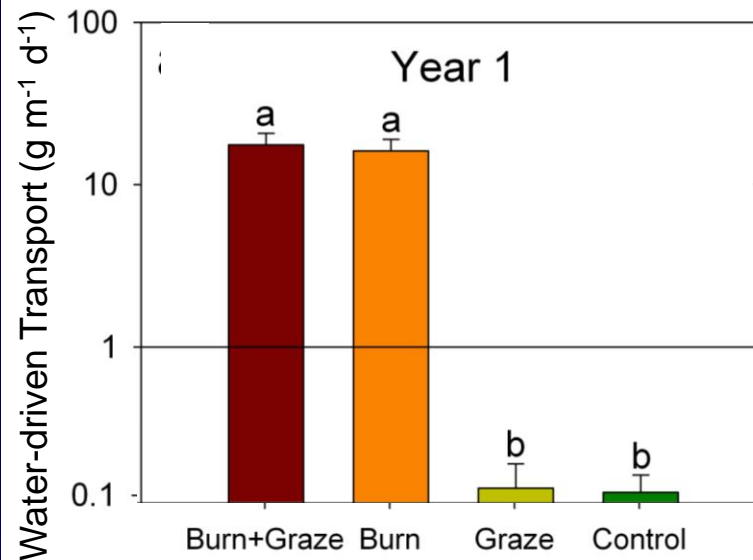


# Land Management Practices



## Water-driven Transport

## Wind-driven Transport



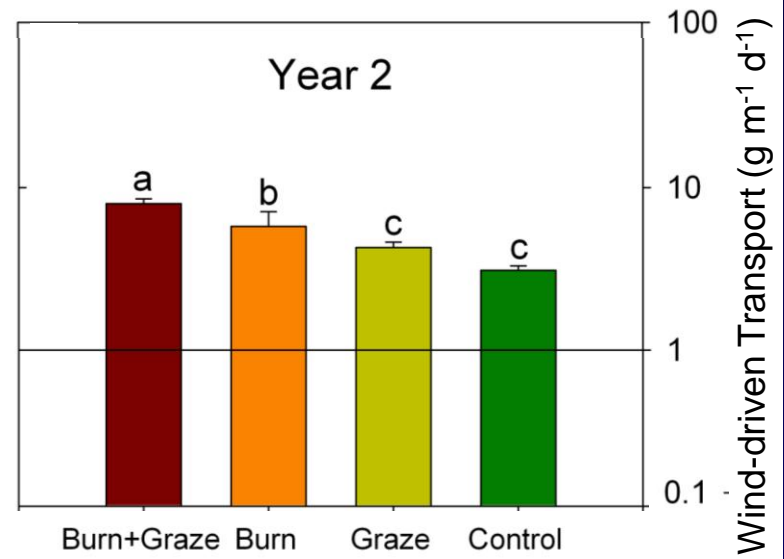
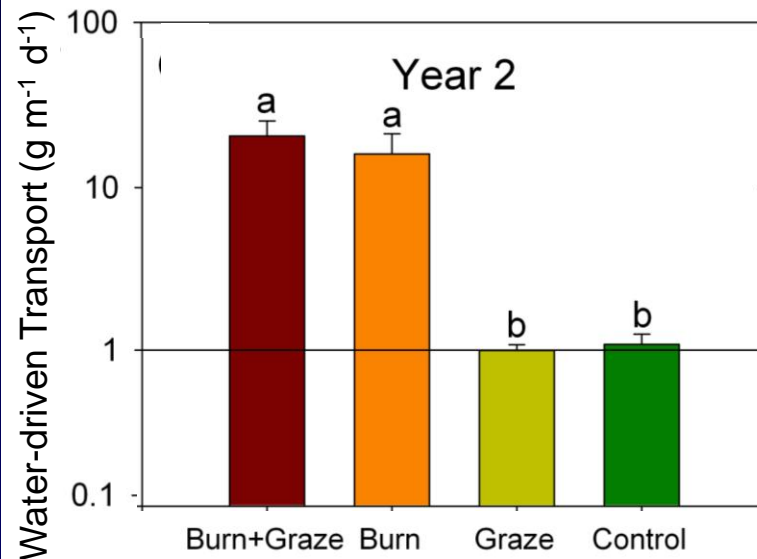
Field et al. (2011) Ecological Applications

# Land Management Practices



## Water-driven Transport

## Wind-driven Transport



Field et al. (2011) Ecological Applications

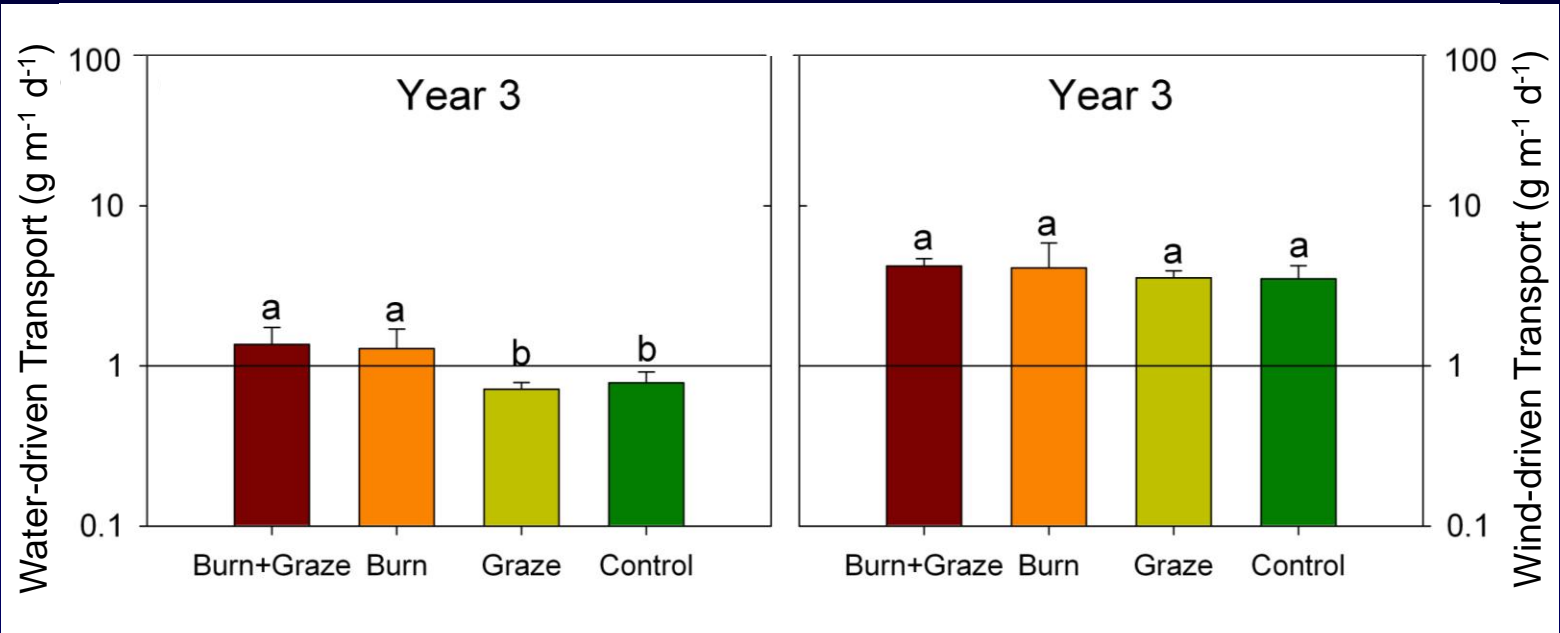


# Land Management Practices



## Water-driven Transport

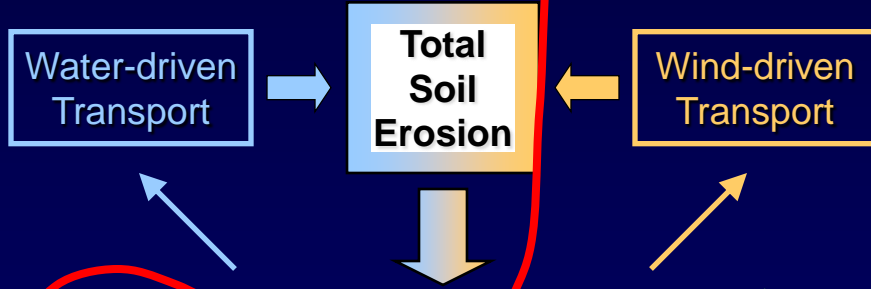
## Wind-driven Transport



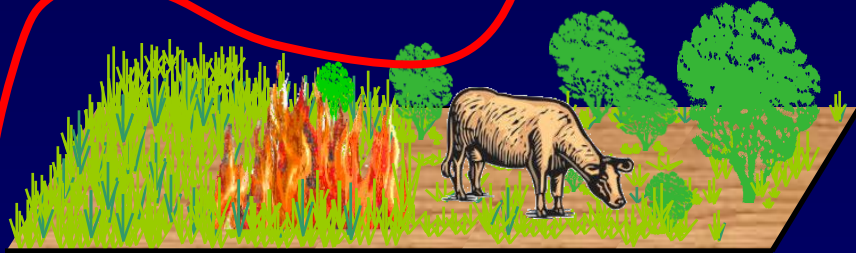
Field et al. (2011) Ecological Applications

# Summary: Wind-driven Transport

**Climatic Conditions**  
(Wet / Dry Extremes)



**Vegetation Dynamics**  
(Land Management Practices)



# Summary: Climate Extremes

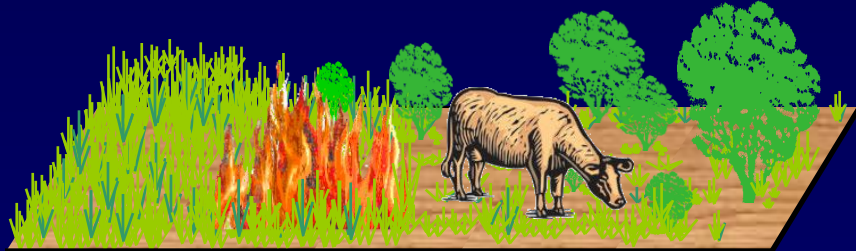
**Climatic Conditions**  
(Wet / Dry Extremes)



Water-driven  
Transport

**Total  
Soil  
Erosion**

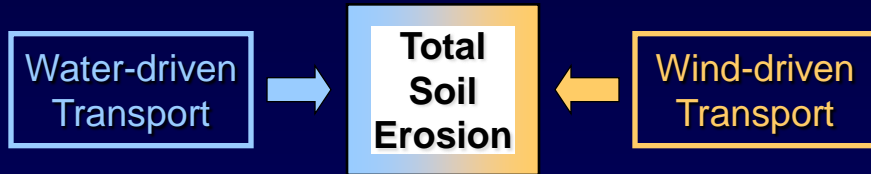
Wind-driven  
Transport



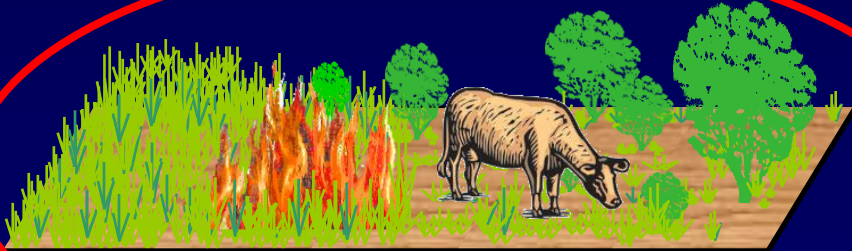
**Vegetation Dynamics**  
(Land Management Practices)

# Summary: Land Management Practices

**Climatic Conditions**  
(Wet / Dry Extremes)



**Vegetation Dynamics**  
(Land Management Practices)





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University of Arizona

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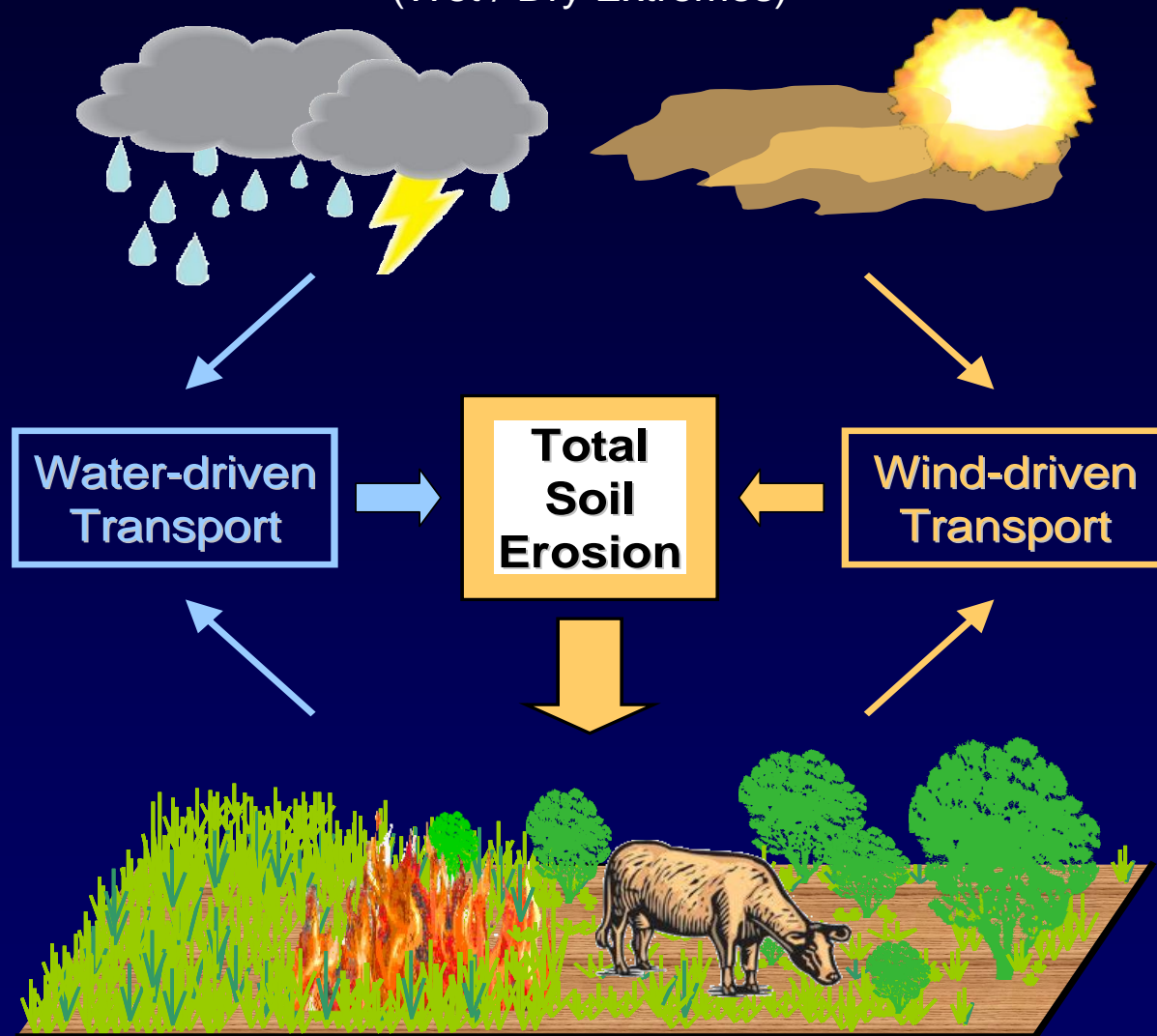
**The Terrestrial Ecology Lab**  
University of Arizona

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## Climatic Conditions (Wet / Dry Extremes)



## Vegetation Dynamics (Land Management Practices)